Plant community types of sand dunes and sand plains in selected areas of the Boreal Natural Region

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Executive Summary

The Alberta Natural Heritage Information Centre (ANHIC) inventories, monitors and disseminates information on biological diversity in Alberta. Detailed data regarding provincial flora, fauna and native plant communities are collected and tracking lists have been developed to monitor elements of biodiversity that are considered rare or have other special significance. Plant communities occurring in areas of unique landforms often support small patch communities that are not well documented in the province. Consequently, information gaps were identified concerning plant communities that inhabit eolian landforms in the boreal forests. Resource Data Branch of Alberta Sustainable Resource Development contracted Wildlands Ecological Consulting Ltd. to identify and inventory plant communities of the boreal sand dunes and sand plains in Holmes Crossing Sandhills Ecological Reserve and a proposed provincial park and natural area near North Buck Lake, Alberta. These sites were chosen as representative eolian landforms of the Boreal Central Mixedwood and Dry Boreal Mixedwood Natural Subregions, respectively.

Eolian landforms in the Holmes Crossing Sandhills Ecological Reserve are predominately a series of well preserved transverse sand dunes with associated parabolic sand dunes and a small section of sand plains. Upland vegetation here is mainly jack pine forest, scattered stands of aspen, black spruce, mixedwood, and small stands of paperbirch and white spruce. Lowland areas support stands of black spruce and tamarack sphagnum bogs. Interdune wetlands were dominated by sedge fens, dwarf birch and willow communities. In the Holmes Crossing Sandhills Ecological Reserve there were very few areas of open sand and no active sand dunes or blowouts were observed. The North Buck Lake study area is drier and is dominated by parabolic sand dunes with larger surface areas of exposed sand. Sand dunes in this study area were stabilised by a similar pattern of vegetation although soils were more xeric influencing plant communities. There is considerable ground disturbance in the North Buck Lake study area as a result of recreational off-road vehicle use. This has affected the vegetation especially in dry open habitats and has led to an increased area of exposed sand. In contrast, the Holmes Crossing Sandhills Ecological Reserve is well signed and most trailheads were blocked to vehicular access. However, there was some ground disturbance at trailheads and All Terrain Vehicle tracks were observed on several backcountry trails and seismic lines.

This study focused on the inventory of natural and semi-natural plant communities. Unique or recurring plant communities were identified in the field and inventoried using standard provincial ecological site and vegetation forms. The concepts for potential plant communities were first developed in the field by tabulating the percent ground cover of dominant species within each stratum for each stand sampled. This preliminary grouping of stands with similar characteristics helped to identify potential communities and to direct sampling efforts. A range of site positions and ecological conditions were investigated in search of unique or recurring plant communities. Field data was then analysed using PC-ORD (Version 4.25) to statistically determine grouping of plant communities using Detrended Correspondence Analysis and agglomerative cluster analysis. The results were critically reviewed and final plant communities were then classified according to The International Classification of Ecological Communities. Descriptive statistics were produced for each community and these were used to compare the community type to other documented types. Based on a literature review, ratings were assigned to reflect the degree of similarity between each type and the current classification.

A total of 64 detailed plots were completed including 32 in each study area. Data analysis resulted in the identification of 31 potential plant community types. These included 17 forest, 7 shrubland and 7 herbaceous vegetation types. There were 5 jack pine types, 1 white spruce, 4 black spruce, 1 tamarack, 4 aspen, and 2 white birch types identified. Shrubland types included 1 bog birch, 2 willow wetlands, 1 green alder, 2 bearberry, and 1 dwarf black spruce - tamarack type. Herbaceous vegetation types included 2 wet sedge fens, 1 bluejoint wet meadow, 1 fowl grass shoreline, 1 Rocky Mountain fescue – plains wormwood xeric opening, 1 hay sedge-poverty oat grass, and 1 slender wheat grass community. There was considerable diversity of plant communities observed during the study and it is recommended that additional sampling be conducted to search for additional plant communities.

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1.0 INTRODUCTION

Alberta Natural Heritage Information Centre (ANHIC) is responsible for the inventory, assessment, and dissemination of information about elements of provincial biodiversity. Elements that are rare or have special conservation concern are included on tracking lists for monitoring and conservation purposes. Allen (2004) provides a preliminary list of Alberta plant community types that are considered "rare or special in some way". ANHIC requires that identification and assessment of plant communities in Alberta follow the standardised classification system developed by the International Classification of Ecological Communities (ICEC). Classification of Alberta plant communities will assist in the development of a Canadian National Vegetation Classification (CNVC). In the United States the ICEC has been adopted to develop a national classification system in that country (Grossman *et al.* 1998, NatureServe 2004, Jennings *et al.* 2003).

In Alberta, ANHIC has identified gaps in the knowledge base of provincial plant community types. Many rare or ecologically sensitive community types occur as small recurring patches associated with unique landforms and specific ecological site conditions. This has resulted in data gaps in plant communities associated with boreal sand dunes and sand plains. The Resource Data Branch of Alberta Sustainable Resource Development (ASRD) contracted Wildlands Ecological to complete an inventory of natural/semi-natural plant communities in the Holmes Crossing and North Buck Lake study areas. These study areas were selected for their representative sand dune and sand plain formations within the Boreal Dry Mixedwood and Boreal Central Mixedwood Natural Subregions.

1.1 Objectives

The following key project objectives were identified:

1) To develop a sampling protocol to collect floristics data on plant communities of the sand dunes and sand plains landscapes of Holmes Crossing Sandhills Ecological Reserve and North Buck Lake study areas;

2) To correlate plant community types identified for the study area with those described for similar areas in Alberta and adjacent jurisdictions, and to apply a similarity rating based on ratings developed by Corns (1983);

3) To develop a plant community classification for sand dune and sand plain natural/near-natural plant communities of the Boreal Dry Mixedwood and Central Mixedwood Natural Subregions;

4) To provide information regarding the spatial extent of proposed plant community types for further evaluation and assignment of a preliminary provincial rank; and

5) To produce a report summarising methodology, results, and identified plant community types.

1.2 Study Areas

The Holmes Crossing Sandhills Ecological Reserve is located south of the Athabasca River approximately 4 km southwest of Fort Assiniboine. It was established as an ecological reserve in 1997 and it occupies about 1 980 ha of Crown land. This Ecological Reserve covers all or portions of sections 7, 8, 9 16, 17, 18, 19, 20, 21, 28 and 29 of Twp. 61 Rge. 6 W4; and sections 12, 13 and 24 of Twp. 61 Rge. 7 W4. Sand dune features include a series of well preserved transverse dunes oriented in a northeast-southwest direction and composites of parabolic sand dunes (David 1977). This study area is located in the Mid Boreal Mixedwood Ecoregion (Strong and Leggat 1992) and the Central Mixedwood Natural Subregion (Alberta Environmental Protection 1994). Appendix I provide a list of common and scientific names of vascular and non-vascular plant species referred to in this report.

The Holmes Crossing transverse dune field is considered to be nationally significant (David 1977; Nelson *et al.* 1989). It occurred within the Lesser Slave Plain District characterised by undulating to rolling fluvial and eolian deposits that form part of the Eastern Alberta Plains physiographic region. This rolling eolian landscape has slope gradients of 0 to 15% while sand dunes have slopes of up to 45%. The Holmes Crossing area is underlain by bentonitic sandstones and shales of the Upper Cretaceous Wapiti Formation Bedrock (Nelson *et al.* 1989). Surficial materials result from glacial deposits acted upon by water and wind erosion. These sand dunes were deposited by wind action as an ancient glacial lake receded. The sand was then quickly colonised by vegetation thus preserving their characteristic profiles. David (1977) suggested that the dunes were likely colonised soon after they were formed as a result of a rapid rise in water tables that provided favourable moisture conditions for plant growth. In a review by Nelson *et al.* (1989), soils in the Holmes Crossing study area consist of unconsolidated mineral matter with limited soil development. They indicated that Brunisols were common under forests stands and Regosols soils occurred on rapidly to poorly drained sites with recent erosion or flooding. Organic soils typically occur under very poorly drained sites, generally in interdune wetlands. Other depressions may have 40 to 60 cm of peat accumulation. Luvisol soils occur less frequently and were found on moderately to strongly rolling, moist eolian and alluvial sands and loamy sands.

The North Buck Lake study area is located approximately 15 km northeast of Boyle, Alberta. It consists of approximately 3 600 ha of Crown Land that is very gently to gently rolling and hummocky. It includes all or portions of sections 19, 20, 29, 30, 31, and 32 Twp. 65 Rge. 17 W4; sections 5 and 6 Twp. 66 Rge. 17 W4; 23, 24, 25, 26, 27, 35 and 36 Twp. 65 Rge. 18 W4; and sections 1, 2, 10, 11 and 12 Twp. 66 Rge. 18 W4. The study area includes a proposed provincial park and natural area located along the west and south sides of North Buck Lake. Eolian landforms in this study area were mainly non-linear and parabolic dunes with sections of sand plains. The proposed provincial park located north and east of Big Johnson (Chump Lake) is an area of remnant terraces with coarse textured glaciofluvial deposits (Hay and O'Leary 1988). The North Buck Lake study area occurs in the Low Boreal Mixedwood Ecoregion (Strong and Leggat 1992) and the Dry Mixedwood Natural Subregion (Alberta Environmental Protection 1994).

Surficial deposits in the Dry Mixedwood and Central Mixedwood Subregions are mainly ground and hummocky moraines or lacustrine materials (Alberta Environmental Protection 1994). The sand dunes and sand outwash plains found in the North Buck Lake study area are not common in the Dry Mixedwood Subregion. Throughout both Subregions soils in the sandy upland areas are typically Brunisols, while Organics and Gleysolic soils are dominant in lowland areas (Alberta Environmental Protection 1994). In sandy areas, jack pine is the dominant tree species while stands of aspen and balsam poplar occur on moister sites. Frequent fires maintain forests in jack pine and aspen with less frequently burned stands succeeding to white spruce and balsam fir. Aspen forests have a high diversity of understorey species while sand dunes and plains mainly support jack pine stands, often with high percent cover of ground lichens. Black spruce and tamarack stands occur in lowland areas, and willow-sedge fens are common on wetter sites. Some peatlands occur in lowland areas.

The climate of the Boreal Forest Natural Region is continental; characterised by short cool summers and long cold winters (Table 1) (Alberta Environmental Protection 1994). Contrasting micro-climatic differences between the south and north facing dune slopes in combination with ecological site conditions has a profound influence on plant community composition and structure (Nelson *et al.* 1989). This results in rapid changes in plant community types in accordance with the pronounced differences in site conditions between upland *versus* lowland sites, and north *versus* south facing slopes. The majority of precipitation falls between May and August, peaking in July. The Central Mixedwood Subregion climate is slightly wetter and cooler than the Dry Mixedwood Subregion (Alberta Environmental Protection 1994).

Table 1. Precipitation and temperature data for the Holmes Crossing and North Buck Lake study areas (Source: Strong and Leggat 1992).

Study Area	**Ecoregion**	**Summer Temperature (C°)**			**Winter Temperature (C°)**			**Annual Precip. (mm)**
		Mean	**Mean Minimum**	**Mean Maximum**	**Mean**	**Mean Minimum**	**Mean Maximum**	
North Buck Lake	Low Boreal Mixedwood	13.8	7.0	20.4	-10.5	-15.8	-5.3	380
Holmes Crossing	Mid Boreal Mixedwood	13.5	7.3	19.6	-13.2	-18.6	-7.7	397

Vegetation overviews of both study areas are provided by Alberta Environmental Protection (1994), Nelson et al. (1989), Strong and Leggat (1992), and Larsen (1990). Aspen and jack pine were the dominant tree species in the study area with aspen forests occurring on well-drained sandy veneers or blankets and jack pine stands on dry rapidly drained transverse or parabolic sand dunes. The understorey in aspen forests were species rich and typically include red-osier dogwood, green alder, prickly rose, willow, saskatoon, bluejoint, hairy wild rye, pea vine, and American vetch. Pine stands were commonly associated with alder, saskatoon, common blueberry, bog cranberry, bearberry, rice grass, lichens and feather mosses. White spruce stands commonly occur along the north facing slopes of drainage channels. White spruce also forms the understorey of aspen stands and in the absence of fire these stands may succeed to white spruce dominated communities. The lower understorey in white spruce stands consists of willow, prickly rose, red-osier dogwood, horsetails, and mosses. Black spruce is common in the area and forms pure stands in imperfectly to poorly drained wetland areas. It also forms mixed stands with white spruce on imperfectly to moderately well drained sites, with tamarack on poorly drained sites, and with aspen on more mesic sites. Black spruce is typically associated with tamarack, willow, dwarf birch, mosses, and sedges. Sedge fens occur on very poorly drained sites and these were eventually invaded by willow and dwarf birch.

Disturbance levels in the two study areas vary. In the Holmes Crossing Sandhills Ecological Reserve, there were few ground disturbances other than existing trails, seismic lines, and roads that were closed to motorised vehicles. By contrast, in the North Buck Lake study area, there has been significant past and present ground disturbance caused primarily by off-road recreational vehicles. In the latter study area there were many trails, roads, and seismic lines.

2.0 METHODS

2.1 Data Collection

Field sampling focused on natural/semi-natural plant associations. Five (5) plots were completed in major plant association types that were poorly correlated to those identified on previous studies. Three (3) plots were placed in poorly correlated minor plant associations that occurred infrequently over the landscape. A potential plant community list was developed by reviewing types previously identified by Nelson et al. (1989), Coenen (2003), Meijer (2002a, 200b, 2002c), Allen (2004) and others. While taking into consideration differences in scale, this list was used as a tentative guide for directing field investigations.

Standard Site Description Forms (RDB 2002-1), Vegetation Description Forms (RDB 2002-3) and Vegetation Inventory Forms (MF5 Rev. 5/99) were used to record detailed plot data, site location, and GPS co-ordinates. Percent cover of vascular and non-vascular plants was estimated occularily within plots. All dominant and co-dominant differential species and other diagnostic species were recorded for each stratum. Photographs of all representative plant associations were taken.

Sampling protocols adhered to the Ecological Land Survey Site (Alberta Sustainable Resource Development 2003). Plot sizes for sites with tree strata were 11.3 m radius (400m^2), and for shrub and herbaceous strata a 5.6 m radius plot (100 m^2) was used. The percent ground cover of all plant species was recorded. Plot dimensions were adjusted to stay within the plant community type where patch sizes were small. Daubenmire transects were used to sample plant communities dominated by graminoids and/or herbaceous cover. In these types a Daubenmire sampling frame (0.20 m x 0.50 m) was placed at 1 m intervals along a 10 m transect (i.e. 10 sub-plots totalling 1.0 m^2). Transects were centred within the 100 m^2 plots depending on the size and distribution of the plant community being sampled. Plant communities occurring in small patches were sampled by reducing the length of the Daubenmire transect to stay within the boundaries of the type. The smallest community to be sampled was 1 m^2 and in this case subplots would be adjacent to each other and covered the entire patch.

2.2 Data Analysis

Three different analyses were used to determine plant community types and species groupings. The first was a subjective grouping based on the initial literature review, field observations and a preliminary review of the data sheets. Field data was then entered into a spreadsheet and imported into PC-ORD Version 4.25 (McCune and Mefferd 1999) for analysis. The second analysis then involved an agglomerative cluster analysis using Ward's linkage method and relative Euclidean distance to measure dissimilarity between plots. The results of this analysis were then graphed as a dendrogram. The third method involved De-trended Correspondence Analysis (DECORANA) which compares similarity and dissimilarity between plot data. The results of the last analysis were plotted graphically on two sets of axis to indicate potential plant communities based on species distribution and groupings. Once community types had been determined summary statistics were calculated for each including mean percent cover, Standard Error of the mean (SE), constancy (% of plots with species), and prominence ($\sqrt{\text{mean cover x constancy}}$).

2.3 Reporting

The framework for plant community descriptions is adapted from protocols established by the International Classification of Ecological Communities (Grossman *et al.* 1998, Jennings *et al.* 2003). Stratum definitions (Table 2) are based on Alberta Sustainable Resource Development (2003). Plant community or plant association classifications refer to existing vegetation including all stages of succession (Braun-Blanquet 1965). Nomenclature for vascular plants follows Moss (1983) with updates according to Flora of North America (1993 - 2004) and ANHIC (2002). Non-vascular plant nomenclature follows Anderson *et al.* (1990) for brown mosses, Anderson (1990) for Sp*hagnum* spp., Stotler and Crandall-Stotler (1977) for liverworts, and Esslinger and Egan (1995) for lichens. Common names generally follow Alberta Environmental Protection (1993).

Table 2. Descriptions and codes used for the various vegetation strata.

Code	Strata
T1	Tree (Main Canopy)
T2	Tree (Understorey)
S1	Tall Shrub (2-5 m)
S2	Medium Shrub (0.5-2 m)
S3	Low Shrub (<0.5 m)

Code	Strata
H	Herbs (Forbs)
G	Graminoids
M	Moss
L	Lichen
E	Epiphytes

2.3.1 Vegetation Classification System

Classification of terrestrial vegetated communities adhered to the standards presented by Grossman *et al.* (1998) and Jennings *et al.* (2003). This hierarchical system lists terrestrial ecological communities first by physiognomic characteristics, and then by floristics. The physiognomic groupings include Class (1), Subclass (2), Group (3), Subgroup (4), and Formation (5).

1) ***Class Level:*** At this level the vegetation structure of the dominant uppermost strata determines the Class as one of the following:
    1. Forest/Woodland – Trees with crowns overlapping (25-100% cover)
    2. Shrubland – Shrubs generally >0.5m tall forming >25% cover
    3. Dwarf-shrubland – Shrubs <0.5m tall forming >25% cover
    4. Herbaceous – Graminoids, ferns and forbs dominate
    5. Nonvascular – bryophytes, lichens and algae dominate
    6. Sparse – Abiotic substrate dominates

2) ***Subclass Level:*** This level is based on the growth-form characteristics of the dominant life form. Generally, this is determined by leaf structure and phenology (e.g. evergreen, deciduous, mixed evergreen/deciduous), persistence (i.e. perennial, annual), and substrate characteristics (e.g. rocks, sand, exposed lakeshore).

3) ***Group Level:*** At this classification level community types were determined by leaf characteristics (broad leaf, needle, scale, etc.). Herbaceous and nonvascular classes were separated based on the presence of woody plant strata. Sparse vegetation communities were separated on the basis of topographic position (e.g. shorelines, cliffs).

4) ***Subgroup Level:*** At this level a further division of each group is based on their Natural/Seminatural or Cultural origins.

5) ***Formation Level:*** The Formation Level is determined by evaluating vegetation physiognomy or structure based on broad environmental factors such as: landscape position and hydrological regime (e.g. Temperate or Subpolar Temperate or Subpolar Deciduous shrubland). An adaptation of the Cowardin System (Grossman et. al 1998) was used to describe hydrological regimes of wetland plant communities.

Floristic Level: There were two final levels in the classification hierarchy both based on floristics. These include the Alliance and the Association both defined by dominant species in the plant community. Jennings *et al.* (2003) document detailed guidelines for describing these levels providing a further refinement of the guidelines initially established by Grossman *et al.* (1998).

1) *Alliance Level:* The alliance is a physiognomically uniform group of plant associations characteristically with one or more diagnostic plant species, generally, occurring in the uppermost stratum

2) *Association Level:* This is the lowest level of the hierarchy and is defined as a plant community type with definite floristic composition, uniform habitat conditions, and uniform physiognomy. Diagnostic species with generally a minimum of 60% constancy were used to describe the type. Species occurring in the uppermost strata were listed first (separated by a hyphen (-) if in the same strata, and a slash (/) if in separate strata) and then diagnostic species in each successive lower level of strata. Species names were listed in decreasing order of dominance or constancy for each stratum.

2.3.2 Floristic Unit Classification Confidence Level

Plant associations described in this report were rated according to our confidence level in the field data and description *as per* Grossman *et al.* (1998) and Jennings *et al.* (2003). For previously described types the rating indicates how well stands match the existing published description for the type. For new types it is based on how common the community type appeared to be in the study area and Alberta, how consistent the floristic composition was between stands, and/or how the stand relates to descriptions of similar types. Based on Jennings *et al.* (2003), Confidence Level 1 (Strong) indicates a high degree of quantitative analysis from detailed plots and that the type is within the known range of distribution for the published type. Level 2 (Moderate) includes types that were poorly correlated to published types, lack quantitative data, and/or distribution of the type is uncertain. Level 3 (Weak) types were based on limited, unpublished, or weak plot data, or qualitative descriptions only. This type may have potential to be listed as distinct plant association type based on observations by qualified researchers. Such types may be recurring over the landscape, have very distinct vegetative physiognomy, and/or dominance and constancy of plant species.

2.3.3 Plant Community Similarity Rating

A literature review was completed to identify similar types within Alberta and North America. This included a thorough search of plant associations and alliances listed by NatureServe (2004) and Allen (2004). The classification scheme and unique identifier code reported for previously identified plant community types was included in each community summary. Brief overviews for each plant community included how common the type was in the study area, typical ecological site conditions, and plant species composition. A literature review was completed for each type and a correlation table compared the similarity of the reviewed type with the current classification. Each plant association was also assigned a similarity rating according to Corns (1983) and Strong (2002). The similarity ratings were based on the following criteria:

Rating	*- Description*
1	Identical to very similar ecological niche and plant species composition.
2	Similar but occupies a slightly different ecological niche or has as slightly different plant species composition.
3	Several similarities but there were important differences in the ecological niche or in the plant species composition.

3.0 RESULTS AND DISCUSSION

3.1 Field Program

A total of 32 plots were completed in each study area between the 12th and 23rd of July 2004. These 64 plots were distributed spatially throughout each study area capturing a wide range of plant community types. Plots P1 to P32 were completed in the Holmes Crossing Sandhills Ecological Reserve and Plots P33 to P64 were completed in the North Buck Lake study area. A variety of site positions and ecological niches were sampled including dry sand dunes, sand plains, riparian areas, sedge fens, peatland bogs, mesic forests, lake shore margins, and other sites. The vegetation in the Holmes Crossing Sandhills Ecological Reserve was found to be largely undisturbed and in a mostly natural state. However, in the North Buck Lake study area there were substantial areas of disturbance caused by recreational off-road vehicle use (Plate 1). Ground disturbances were mainly observed in grasslands, herb fields, forest openings, open forests, shoreline margins, and other open areas permitting easy access. Plant communities in both study areas were mainly composed of indigenous species with generally only minor occurrence of introduced or invasive species.

Plate 1. Ground disturbance caused by off-road vehicle use in the North Buck Lake study area.

Soil textures throughout the majority of both study areas consisted of fine sands under jack pine forests, dry shrublands, herbaceous openings and other submesic to xeric communities. Commonly the duff and organic layer in these stands was less than 1 to 2 cm thick. In more mesic closed canopy jack pine stands the organic component was usually 3 to 5 cm thick over fine sands. Aspen stands typically had a 3 to 5 cm duff layers with a 3 to 7 cm depth of loamy fine sand layer over fine sand. Lowland black spruce stands often had a 5 to 12 cm duff layer over fine sand. In wetland areas the organic layer was usually greater than 25 cm.

Sand dunes and sand plains in both study areas were generally well stabilised by established graminoid, herbaceous, or forest cover vegetation. Likely due to the slightly higher moisture levels, uplands in the Holmes Crossing Sandhills Ecological Reserve supported mainly closed canopy forests and lowlands were densely vegetated with either black spruce bogs or sedge-shrub fens. In the Holmes Crossing area there were only a few small areas with significant patches of exposed soil that were mostly associated with disturbances along trails. No significant blowouts or other active sand areas were observed. The North Buck Lake study area also supported a range of mature well-established vegetation communities. However, in contrast to the Holmes Crossing Sandhills Ecological Reserve there were more small patches of open sand and exposed soil associated with sparse grassland cover, dry-land herbaceous vegetation, or with dry forest openings. As noted above many of these areas also had some level of ground disturbance caused by off-road vehicle use. In the absence of these disturbances it is expected that herbaceous and graminoid cover levels would be higher and exposed soil values would be lower. Plots completed on the current study avoided areas with obvious disturbance.

3.2 Data Analysis

Analysis of plot data resulted in the identification of 31 potential plant associations including 17 forest, 7 shrubland and 7 herbaceous vegetation plant communities. There were 5 jack pine types, 1 white spruce, 4 black spruce, 1 tamarack, 4 aspen and 2 white birch types identified. Shrubland types included 1 bog birch, 2 willow wetlands, 1 green alder, and 2 bearberry types. Herbaceous Vegetation types included 2 wet sedge fens, 1 bluejoint wet meadow, 1 fowl grass shoreline, 1 Rocky Mountain fescue – plains wormwood xeric opening, 1 hay sedge-poverty oat grass, and 1 slender wheat grass community.

The final plant community types were determined by comparing the list of types generated by the fieldwork against an evaluation of the cluster analysis groupings that is displayed in the dendogram presented in Figure 1. Output results of the DCA analysis (PC-ORD Version 4.25) are presented in Appendix II and plotted in Figure 2. All data analysis was completed using plant species cover separated out by strata and the final analysis of community types took this factor into account. For example in Figure 2, Plot 18 appeared to be a unique type but upon closer examination there was substantial cover of mature aspen in the T2 stratum and therefore it was grouped with Plots 3, 17, 23, and 50. Assessment of these combined plots resulted in the concept for the *Populus tremuloides / Alnus viridis / Aralia nudicaulis* Forest community type.

Figure 1. Dendogram displaying the plot groupings produced through agglomerative cluster analysis.

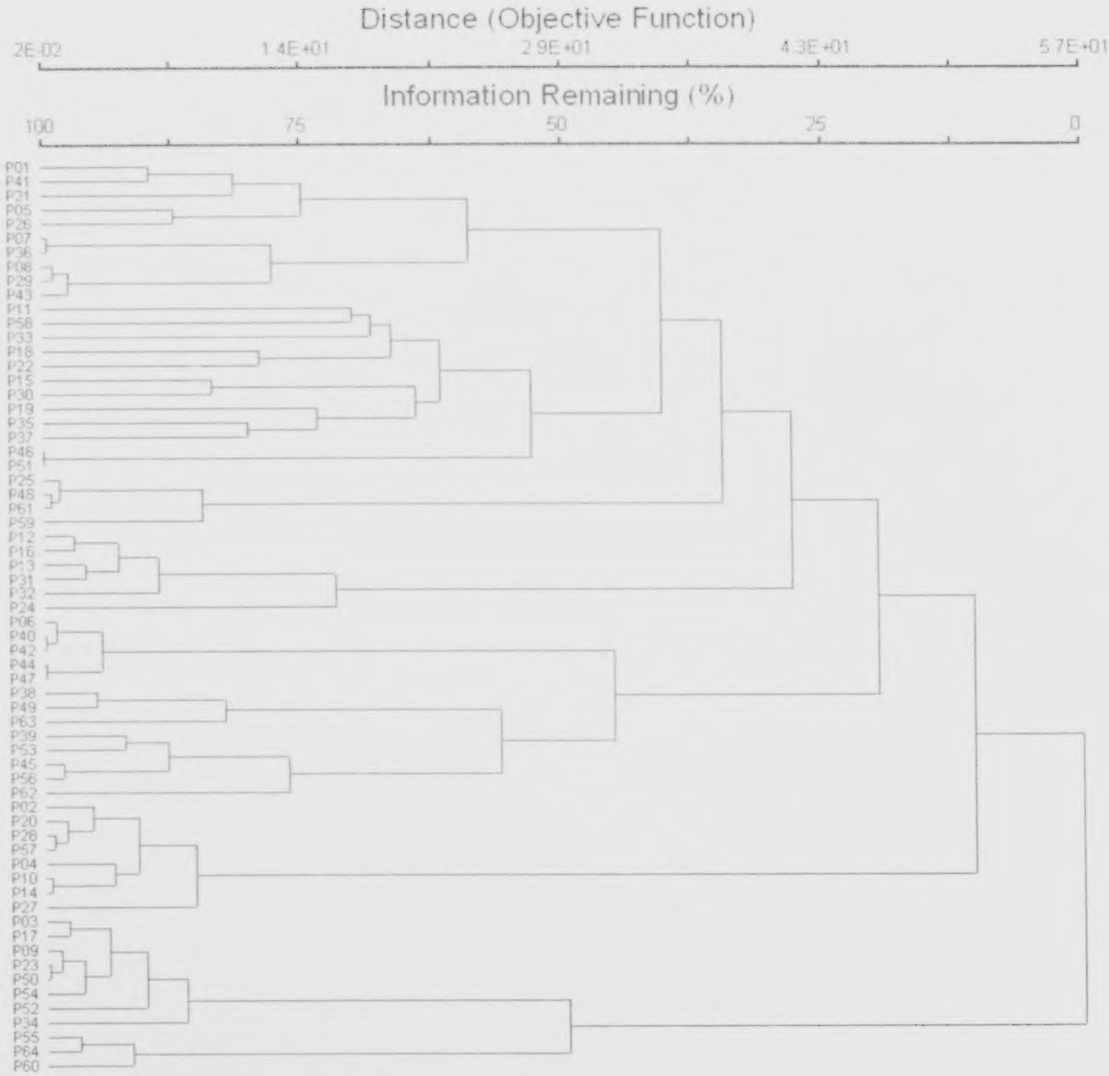
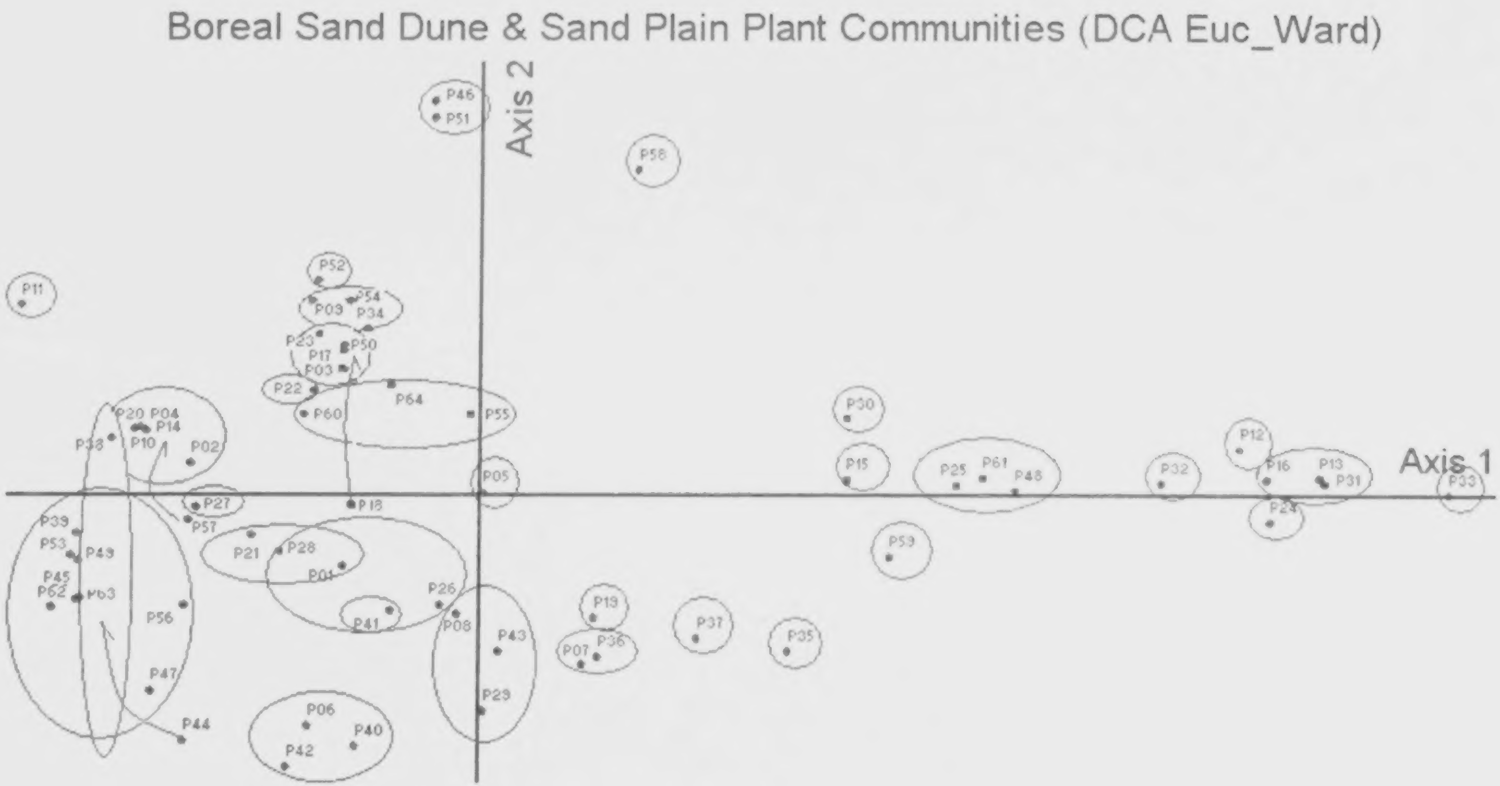


Figure 2. Diagram of plot ordination, with plant community groupings, based on Detrended Correspondence Analysis (DCA) of plot data.



3.3 Classifications

In this section each plant community type (CT) is named and characterised in terms of typical site conditions and plant species composition. The proposed or existing ICEC classification scheme with unique identifier code and a classification confidence level are also presented. Following this is a list of dominant, co-dominant and diagnostic (>60% constancy) species for each type. Generally, plants species were recorded in diminishing order of dominance or importance starting with the upper stratum and moving progressively towards lower strata (i.e. T1 layer to M layer). For each type a plot summary table with descriptive statistics is provided. Literature reviews describe similar community types found in Alberta and other jurisdictions in North America. Finally a correlation table is included with similarity ratings for each reviewed type compared to the classification being discussed. Colour plates showing representative plant communities for the each type are included immediately after their summaries. Plot numbers for each photo are indicated at the end of the plate captions.

3.3.1 Forest

3.3.1.1 *Pinus banksiana / Vaccinium* spp. */ Pleurozium schreberi* Forest

Jack Pine / Blueberry species / Schreber's moss Forest

This community was common in both the Holmes Crossing Sandhills Ecological Reserve and the North Buck Lake study area where it occurred on cool north to northeast aspects. Slope gradients were normally gentle ranging between 5% and 22%. Site positions were commonly toe and lower slopes, however this community type may extend to upper slopes. Soils were typically well-drained with mesic to sub-mesic moisture levels and a mesotrophic nutrient regime. These stands had closed canopies of *Pinus banksiana* that may include a minor amount of *Populus tremuloides* as scattered trees. The shrub layer consisted of *Ledum groenlandicum, Vaccinium myrtilloides,* and *Alnus viridis.* Other common plants included *Vaccinium vitis-idaea, Cornus canadensis, Aralia nudicaulis, Maianthemum canadense,* and *Linnaea borealis. Pleurozium schreberi* formed a dense carpet of moss with lesser amounts of *Hylocomium splendens. Usnea* spp. was a common epiphyte in these stands and it may have significant percent cover. A summary of the vascular and non-vascular plant species occurring in this type is provided in Table 3. There was considerable variation in the dominance of plant species (e.g. *Vaccinium* spp.) within the plots completed and additional sampling may result in splitting these into two or more community types. For example, Plot # 8 fit well in terms of floristics but in contrast it also had significant cover of *Populus tremuloides* (10%) and *Aralia nudicaulis* (15%).

Class: Forest
Subclass: Evergreen forest
Group: Temperate or subpolar needle-leaved evergreen forest
Subgroup: Natural/Semi-natural
Formation: Rounded-crowned temperate or subpolar needle-leaved evergreen forest
Alliance: *Pinus banksiana* Forest
Association: *Pinus banksiana / Vaccinium* spp. */ Pleurozium schreberi* Forest
Unique Identifier: n/a
Classification Confidence Level: 2 (Moderate) Only three (3) plots were completed for this type and there was considerable variation in floristics among plots and in the literature describing similar types. This type is widespread throughout the boreal region.

Dominant Species: *Pinus banksiana, Pleurozium schreberi, Hylocomium splendens, Usnea* spp.
Co-Dominant Species: *Populus tremuloides, Pinus banksiana, Alnus viridis, Vaccinium myrtilloides, Vaccinium vitis-idaea, Ledum groenlandicum, Cornus canadensis, Aralia nudicaulis, Maianthemum canadense*

Table 3. Summary of plot data and descriptive statistics for the *Pinus banksiana / Vaccinium* spp. / *Pleurozium schreberi* community type (n=3).

			Plots						
Strata	**Code**	**Species**	**P08**	**P29**	**P43**	**Mean**	**SE**	**Constancy**	**Prominence**
M	PLEUSCH	*Pleurozium schreberi*	60.0	90.0	86.0	78.7	9.4	100.0	88.7
T1	PINUBAN	*Pinus banksiana*	30.0	50.0	10.0	30.0	11.5	100.0	54.8
E	USNEA$$$	*Usnea* spp.	25.0	5.0	5.0	11.7	6.7	100.0	34.2
M	HYLOSPL	*Hylocomium splendens*	6.0	5.0	0.1	3.7	1.8	100.0	19.2
S3	LEDUGRO	*Ledum groenlandicum*	0.1	1.0	9.0	3.4	2.8	100.0	18.3
S3	VACCMYR	*Vaccinium myrtilloides*	1.0	0.1	8.0	3.0	2.5	100.0	17.4
S3	VACCVIT	*Vaccinium vitis-idaea*	0.1	0.0	10.0	3.4	3.3	66.7	15.0
T2	PINUBAN	*Pinus banksiana*	0.0	0.0	20.0	6.7	6.7	33.3	14.9
S1	ALNUVIR	*Alnus viridis*	6.0	3.0	0.0	3.0	1.7	66.7	14.1
H	ARALNUD	*Aralia nudicaulis*	15.0	0.0	0.0	5.0	5.0	33.3	12.9
T1	POPUTRE	*Populus tremuloides*	10.0	0.0	0.0	3.3	3.3	33.3	10.5
H	MAIACAN	*Maianthemum canadense*	1.0	0.1	2.0	1.0	0.5	100.0	10.2
S3	CORNCAN	*Cornus canadensis*	4.0	0.1	0.0	1.4	1.3	66.7	9.5
T2	BETUPAP	*Betula papyrifera*	0.0	2.0	2.0	1.3	0.7	66.7	9.4
S3	LINNBOR	*Linnaea borealis*	1.0	0.1	1.0	0.7	0.3	100.0	8.4
M	DICRPOL	*Dicranum polysetum*	0.0	3.0	0.1	1.0	1.0	66.7	8.3
M	PTILCRI	*Ptilium crista-castrensis*	3.0	0.0	0.1	1.0	1.0	66.7	8.3
S1	PINUBAN	*Pinus banksiana*	0.0	0.0	5.0	1.7	1.7	33.3	7.5
E	EPIPHYT	*Epiphyte* spp.	0.0	5.0	0.0	1.7	1.7	33.3	7.5
S2	PICEGLA	*Picea glauca*	1.0	0.0	1.0	0.7	0.3	66.7	6.7
S3	PRUNVIR	*Prunus virginiana*	3.0	0.0	0.0	1.0	1.0	33.3	5.8
S3	ROSAACI	*Rosa acicularis*	3.0	0.0	0.0	1.0	1.0	33.3	5.8
S3	PINUBAN	*Pinus banksiana*	0.0	0.0	1.0	0.3	0.3	33.3	3.3
T2	PICEMAR	*Picea mariana*	0.0	1.0	0.0	0.3	0.3	33.3	3.3
S3	ARCTUVA	*Arctostaphylos uva-ursi*	0.0	0.0	1.0	0.3	0.3	33.3	3.3
L	CLADMIT	*Cladina mitis*	0.0	0.0	1.0	0.3	0.3	33.3	3.3
S1	BETUPAP	*Betula papyrifera*	1.0	0.0	0.0	0.3	0.3	33.3	3.3
S1	PICEMAR	*Picea mariana*	0.0	1.0	0.0	0.3	0.3	33.3	3.3
H	CAMPROT	*Campanula rotundifolia*	0.1	0.1	0.1	0.1	0.0	100.0	3.2
G	ORYZPUN	*Oryzopsis pungens*	0.1	0.0	0.1	0.1	0.0	66.7	2.1
H	EPILANG	*Epilobium angustifolium*	0.1	0.1	0.0	0.1	0.0	66.7	2.1
L	CLADONI	*Cladonia* spp.	0.1	0.1	0.0	0.1	0.0	66.7	2.1
G	ELYMINN	*Leymus innovatus*	0.1	0.1	0.0	0.1	0.0	66.7	2.1
S3	RUBUIDA	*Rubus idaeus*	0.1	0.1	0.0	0.1	0.0	66.7	2.1
S3	PICEGLA	*Picea glauca*	0.0	0.0	0.1	0.0	0.0	33.3	1.1
S3	BETUPAP	*Betula papyrifera*	0.1	0.0	0.0	0.0	0.0	33.3	1.1
S3	PRUNPEN	*Prunus pensylvanica*	0.0	0.0	0.1	0.0	0.0	33.3	1.1
T2	POPUTRE	*Populus tremuloides*	0.1	0.0	0.0	0.0	0.0	33.3	1.1
S2	SALIBEB	*Salix bebbiana*	0.0	0.1	0.0	0.0	0.0	33.3	1.1
H	GALIBOR	*Galium boreale*	0.1	0.0	0.0	0.0	0.0	33.3	1.1
S2	PRUNPEN	*Prunus pensylvanica*	0.1	0.0	0.0	0.0	0.0	33.3	1.1
H	MELALIN	*Medicago lupulina*	0.0	0.0	0.1	0.0	0.0	33.3	1.1
H	DRYOCAR	*Dryopteris carthusiana*	0.1	0.0	0.0	0.0	0.0	33.3	1.1
M	POLYPIL	*Polytrichum piliferum*	0.1	0.0	0.0	0.0	0.0	33.3	1.1
S2	POPUTRE	*Populus tremuloides*	0.1	0.0	0.0	0.0	0.0	33.3	1.1
H	VIOLREN	*Viola renifolia*	0.1	0.0	0.0	0.0	0.0	33.3	1.1

Diagnostic Species: *Pinus banksiana, Vaccinium myrtilloides, Vaccinium vitis-idaea, Ledum groenlandicum, Linnaea borealis, Maianthemum canadense, Pleurozium schreberi, Hylocomium splendens, Usnea* spp.

Literature Review:

Nelson *et al.* (1989) identified a *Pinus banksiana / Alnus crispa / Linnaea borealis - Vaccinium vitis-idaea* community that occurred in the Holmes Crossing Sandhills Ecological Reserve. This type also occupied similar sites and was composed of largely the same plant species. The main differences were its higher cover of *Alnus viridis* (>20% mean cover), *Linnaea borealis* (27%), *Prunus pensylvanicus* (7%), *Vaccinium vitis-idaea* (18%), *Hylocomium splendens* (10%), lack of *Ledum groenlandicum*, and substantially less cover of *Pleurozium schreberi*.

Meijer (2002c) identified a *Pinus banksiana / Vaccinium myrtilloides / Pleurozium schreberi* type from the Marguerite Crag and Tail Wildland Provincial Park in northeastern Alberta. This type had 60% cover of *Vaccinium myrtilloides*, 3% cover of *V. vitis-idaea*, and *Pleurozium schreberi* cover was lower at 40%. Another similar type that was recorded from this Park was the *Pinus banksiana / Pleurozium schreberi* community type (Meijer 2002c). This community was also quite similar in species composition but only had trace amounts of *Vaccinium myrtilloides* and *V. vitis-idaea*. Raup and Argus (1982) provide a general description of a *Pinus banksiana (Picea mariana) / Ledum groenlandicum* type that occupied lowland pine stands in the Lake Athabasca area. Associated plant species included *Kalmia polifolia, Andromeda polifolia, Chamaedaphne calyculata*, and *Vaccinium uliginosum*. Herbs included *Calamagrostis canadensis, Spiranthes romanzoffiana* and *Lycopus uniflorus*. Raup and Argus (1982) described a second type that was an interdune lowland forest consisted of *Picea mariana, Pinus banksiana, Betula papyrifera, Alnus crispa, Ledum groenlandicum, Goodyera repens, Geocaulon lividum, Empetrum nigrum, Arctostaphylos uva-ursi*, and *Vaccinium vitis-idaea*. Mackenzie River Basin Committee (1981) identified a *Pinus banksiana - Ledum groenlandicum* community at Lake Athabasca. Important shrubs included *Ledum groenlandicum, Vaccinium myrtilloides*, and *Chamaedaphne calyculata*. Mosses included *Pleurozium schreberi, Polytrichum juniperinum*, and *Sphagnum fuscum*.

NatureServe (2004) lists a *Pinus banksiana / Vaccinium* spp. */ Pleurozium schreberi* Forest (CEGL002441). It occurred on flat to rolling topography and ranges from Maine to Minnesota in the United States and from New Brunswick to Manitoba (Greenall 1996, Zoladeski, *et al.* 1995). Soils were typically sandy loams, fine sands, and loamy sands. Stands were dominated by *Pinus banksiana* but may include small amounts of *Betula papyrifera, Picea mariana, Pinus resinosa*, and *Populus tremuloides*. Common shrubs included *Alnus viridis* and *Amelanchier alnifolia*, and in the midwest *Quercus* spp. Low shrub cover was significant and consisted of *Arctostaphylos uva-ursi, Diervilla lonicera, Juniperus communis, Linnaea borealis, Rosa acicularis*, and *Vaccinium* spp. Common herbs include *Aralia nudicaulis, Anemone quinquefolia, Cornus canadensis, Fragaria virginiana, Maianthemum canadense*, and *Trientalis borealis*. Moss cover was dense and consisted mainly of *Pleurozium schreberi*.

A second similar type listed by NatureServe (2004) is the *Pinus banksiana - (Picea mariana, Pinus strobus) / Vaccinium* spp. Rocky Woodland (CEGL002483). This type was recorded for Minnesota, Ontario and possibly Quebec. Sites were variable but it usually occurred on shallow, sandy or rocky sites or on talus slopes and bare bedrock to deep mineral soils of coarse to fine sand. Stands had an open canopy consisting of *Pinus banksiana* and *Picea mariana*. The shrub layer was open and may have included *Picea mariana, Vaccinium angustifolium* and *Vaccinium myrtilloides*. The sparse herb/graminoid consisted of *Cornus canadensis, Maianthemum canadense*, and *Melampyrum lineare*. *Dicranum polysetum* and *Pleurozium schreberi* formed the moss layer and lichen cover included *Cladina rangiferina, Cladina mitis*, and *Cladina stellaris*.

A third type described by NatureServe (2004) is the *Pinus banksiana - Picea mariana / Vaccinium* spp. / *Pleurozium schreberi* Forest (CEGL002448). This latter type occurred across the boreal regions of Canada including Manitoba (Greenall 1996), Ontario, possibly Quebec, and northern portions of the United States. Sites were level to gentle upper and lower slopes. Soils were sands, coarse loams, or silts often with boulders at the surface. The overstorey consisted mainly of *Pinus banksiana* and *Picea mariana* was often co-dominant. Some cover of *Abies balsamea, Acer rubrum, Picea glauca*, and *Populus tremuloides* may also be common. The shrub layer typically included *Alnus viridis, Amelanchier* spp., *Corylus cornuta, Diervilla lonicera, Gaultheria procumbens, Vaccinium angustifolium*, and *Vaccinium myrtilloides*. The herb layer was sparse consisting of *Eurybia macrophylla (= Aster macrophyllus), Clintonia borealis, Cornus canadensis*, and *Maianthemum canadense*. The dense moss layer was dominated by *Pleurozium schreberi*.

Another related community listed by NatureServe (2004) was the *Pinus contorta - (Picea mariana) / Vaccinium vitis-idaea / Hylocomium splendens - Pleurozium schreberi* Forest (CEGL002731). This community was widespread in northeastern British Columbia, Alberta, and southwestern Yukon (Allen *et al*. 2004). Dominants in the overstorey include *Pinus contorta var. contorta* with *Picea mariana*. Shrub cover consisted of *Ledum groenlandicum* with some *Rosa acicularis* and *Vaccinium myrtilloides*. Moss cover was dense consisting of *Pleurozium schreberi, Hylocomium splendens*, and *Ptilium crista-castrensis*. Similarity ratings for related plant community types are provided in Table 4.

Table 4. Correlation table of plant community types with similarity ratings for the *Pinus banksiana / Vaccinium* spp. / *Pleurozium schreberi* type.

Similar Types	Similarity Rating	Comments
Pinus banksiana / Alnus crispa / Linnaea borealis – Vaccinium vitis-idaea CT (Nelson *et al*. 1989)	2	A very similar community type but with a different array of dominant plant species and higher cover of *Alnus crispa* and *Vaccinium vitis-idaea*.
Pinus banksiana / Vaccinium myrtilloides / Pleurozium schreberi CT (Meijer 2002c)	2(1)	Relatively good fit with the current type in terms of plant species composition and ground cover.
Pinus banksiana / Pleurozium schreberi CT (Meijer 2002c)	2(3)	Similar species composition but much less cover of *Vaccinium myrtilloides* and *V. vitis-idaea*.
Pinus banksiana (Picea mariana) / Ledum groenlandicum CT (Raup and Argus 1982)	3	A broad type found in ecotones between lowland black spruce and upland pine stands. It appears to have more wetland species typical of black spruce/tamarack types.
Picea mariana, Pinus banksiana, Betula papyrifera, Alnus crispa, Ledum groenlandicum, Vaccinium vitis-idaea CT(Raup and Argus 1982)	3	A lowland forest type that has some similarity to the current type but no indication that *Vaccinium myrtilloides* was an important species and no percent covers were provided.
Pinus banksiana - Ledum groenlandicum CT (Mackenzie River Basin Comm. 1981)	3	Similar type but appears to have higher cover of *Ledum groenlandicum*.
Pinus banksiana / Vaccinium spp. / *Pleurozium schreberi* Forest CEGL002441 (NatureServe 2004)	3(2)	Reported for northern parts of the midwestern United States and in central Canada. The floristics was very similar but included eastern species not found in Alberta.
Pinus banksiana - (Picea mariana, Pinus strobus) /Vaccinium spp. Rocky Woodland (CEGL002483) (NatureServe 2004)	3(2)	Site conditions may be quite different than those for the present type. It does not include a deciduous component and *Picea mariana* cover was significant. Included eastern species not found in Alberta (e.g. *Pinus strobus*).
Pinus banksiana – Picea mariana / Vaccinium spp. / *Pleurozium schreberi* Forest (CEGL002448) (NatureServe 2004)	2	A very similar type with many species in common with the current type but included some eastern species not indigenous to Alberta.
Pinus contorta - (Picea mariana) / Vaccinium vitis-idaea / Hylocomium splendens – Pleurozium schreberi Forest (CEGL002731) (NatureServe 2004)	3	This type has a very similar species composition within the shrub, herb, and moss layer but the dominant tree was *Pinus contorta*. The shrub layer has more *Ledum groenlandicum* and less *Vaccinium* spp.

3.3.1.2 *Pinus banksiana / Alnus viridis - Vaccinium myrtilloides / Oryzopsis pungens* Forest
Jack Pine / Green Alder - Common Blueberry / Northern Rice Grass Forest

This was a species rich stand type that appears to be common in the Holmes Crossing Sandhills Ecological Reserve (Table 5). No plots were completed in the North Buck Lake study area, however, similar stands may occur there as well. This community occurred on well-drained sites with minimal slope gradients (5-9%), subxeric to submesic moisture levels, and a submesotrophic to mesotrophic nutrient regime. Surface substrate cover was mainly organic matter (94% mean), exposed mineral soil (5%), and a trace of decaying wood. *Pinus banksiana* formed a closed (40%) to moderately open (20%) overstorey canopy. Important species in the shrub layer were *Alnus viridis, Vaccinium myrtilloides,* and *Arctostaphylos uva-ursi*. Other shrubs with high constancy included *Prunus virginiana, Amelanchier alnifolia,* and *Vaccinium vitis-idaea*. *Oryzopsis pungens* and *Maianthemum canadense* dominated the herb/graminoid layer. Other constant species included *Elymus trachycaulus, Erigeron glabellus, Galium boreale, Carex siccata,* and *Schizachne purpurascens*. Moss cover consisted of *Pleurozium schreberi* at approximately 13% cover with trace amounts of *Dicranum polysetum,* and *Polytrichum piliferum*. *Cladina mitis* was a constant species but had less than 2% cover. *Cladina rangiferina* was often present as well. There was considerable variability in the plots and additional sampling of this type was required to more accurately determine typical percent covers, especially of *Oryzopsis pungens*.

Class: Forest
Subclass: Evergreen forest
Group: Temperate or subpolar needle-leaved evergreen forest
Subgroup: Natural/Semi-natural
Formation: Rounded-crowned temperate or subpolar needle-leaved evergreen forest
Alliance: *Pinus banksiana* Forest
Association: *Pinus banksiana / Alnus viridis - Vaccinium myrtilloides / Oryzopsis pungens* Forest
Unique Identifier: n/a
Classification Confidence Level: 1 (Weak) Only two (2) plots completed and there was limited reference to similar types in the literature. Geographical distribution was unknown.

Dominant Species: *Pinus banksiana, Alnus viridis, Vaccinium myrtilloides, Maianthemum canadense, Oryzopsis pungens*
Co-Dominant Species: *Prunus virginiana, Amelanchier alnifolia, Arctostaphylos uva-ursi, Vaccinium vitis-idaea, Elymus trachycaulus, Pleurozium schreberi, Cladina mitis, Cladina rangiferina*
Diagnostic Species: *Pinus banksiana, Alnus viridis, Vaccinium myrtilloides, Arctostaphylos uva-ursi,, Maianthemum canadense, Erigeron glabellus, Galium boreale, Carex siccata, Schizachne purpurascens, Oryzopsis pungens, Cladina mitis*

Literature Review:

Nelson *et al.* (1989) described a *Pinus banksiana / Arctostaphylos uva-ursi / Cladina* spp. community type that occurred in the Holmes Crossing Sandhills Ecological Reserve. The species composition of this type and the current type was virtually identical. However, the current classification had higher constancy and greater percent cover of *Alnus viridis, Vaccinium myrtilloides,* and *Oryzopsis pungens*. It also had considerably less cover of *Arctostaphylos uva-ursi*. A second type identified by Nelson *et al.* (1989) was a *Pinus banksiana – Populus tremuloides / Linnaea borealis - Vaccinium vitis-idaea* community. This type was a mixed stand that was more mesic. Mean percent cover values for *Alnus viridis, Vaccinium myrtilloides,* and *Oryzopsis pungens* were all substantially lower in this type. Timoney and Robinson (1998) noted a *Pinus banksiana / Arctostaphylos uva-ursi / Oryzopsis pungens* community type that occurred in Ft. Assiniboine Sandhills Wildland Park. This type was a parkland-like mosaic of dry savannah and jack pine forest.

Table 5. Summary of plot data and descriptive statistics for the *Pinus banksiana / Alnus viridis - Vaccinium myrtilloides / Oryzopsis pungens* community type (n=2).

			Plots					
Strata	**Code**	**Species**	**P01**	**P21**	**Mean**	**SE**	**Constancy**	**Prominence**
T1	PINUBAN	*Pinus banksiana*	40.0	20.0	30.0	10.0	100.0	54.8
S1	ALNUVIR	*Alnus viridis*	50.0	3.0	26.5	23.5	100.0	51.5
G	ORYZPUN	*Oryzopsis pungens*	3.0	30.0	16.5	13.5	100.0	40.6
H	MAIACAN	*Maianthemum canadense*	25.0	1.0	13.0	12.0	100.0	36.1
S3	VACCMYR	*Vaccinium myrtilloides*	9.0	9.0	9.0	0.0	100.0	30.0
L	CLADMIT	*Cladina mitis*	9.0	6.0	7.5	1.5	100.0	27.4
S3	ARCTUVA	*Arctostaphylos uva-ursi*	10.0	3.0	6.5	3.5	100.0	25.5
M	PLEUSCH	*Pleurozium schreberi*	25.0	0.0	12.5	12.5	50.0	25.0
S3	VACCVIT	*Vaccinium vitis-idaea*	15.0	0.0	7.5	7.5	50.0	19.4
S3	AMELALN	*Amelanchier alnifolia*	0.0	10.0	5.0	5.0	50.0	15.8
S1	PRUNVIR	*Prunus virginiana*	10.0	0.0	5.0	5.0	50.0	15.8
G	ELYMTRA	*Elymus trachycaulus*	2.0	2.0	2.0	0.0	100.0	14.1
L	CLADRAN	*Cladina rangiferina*	8.0	0.0	4.0	4.0	50.0	14.1
S2	ROSAACI	*Rosa acicularis*	6.0	0.0	3.0	3.0	50.0	12.2
S1	AMELALN	*Amelanchier alnifolia*	6.0	0.0	3.0	3.0	50.0	12.2
H	ARALNUD	*Aralia nudicaulis*	5.0	0.0	2.5	2.5	50.0	11.2
S3	PRUNVIR	*Prunus virginiana*	0.0	4.0	2.0	2.0	50.0	10.0
H	GALIBOR	*Galium boreale*	1.0	0.1	0.6	0.5	100.0	7.4
G	CARESIC	*Carex siccata*	0.1	1.0	0.6	0.5	100.0	7.4
S3	POPUTRE	*Populus tremuloides*	0.0	2.0	1.0	1.0	50.0	7.1
E	EPIPHYT	*Epiphyte* spp.	0.0	2.0	1.0	1.0	50.0	7.1
S3	ROSAACI	*Rosa acicularis*	0.0	1.0	0.5	0.5	50.0	5.0
H	EPILANG	*Epilobium angustifolium*	0.5	0.0	0.3	0.3	50.0	3.5
S2	SHEPCAN	*Shepherdia canadensis*	0.5	0.0	0.3	0.3	50.0	3.5
T2	PICEGLA	*Picea glauca*	0.5	0.0	0.3	0.3	50.0	3.5
S1	POPUTRE	*Populus tremuloides*	0.5	0.0	0.3	0.3	50.0	3.5
G	SCHIPUR	*Schizachne purpurascens*	0.1	0.1	0.1	0.0	100.0	3.2
H	CAMPROT	*Campanula rotundifolia*	0.1	0.1	0.1	0.0	100.0	3.2
H	ANEMMUL	*Anemone multifida*	0.1	0.1	0.1	0.0	100.0	3.2
H	ERIGGLA	*Erigeron glabellus*	0.1	0.1	0.1	0.0	100.0	3.2
H	VIOLADU	*Viola adunca*	0.1	0.1	0.1	0.0	100.0	3.2
H	ASTELAE	*Aster laevis*	0.1	0.1	0.1	0.0	100.0	3.2
G	FESTSAX	*Festuca saximontana*	0.1	0.1	0.1	0.0	100.0	3.2
G	POAPRAT	*Poa pratensis*	0.1	0.1	0.1	0.0	100.0	3.2
H	ASTRSTR	*Astragalus striatus*	0.1	0.1	0.1	0.0	100.0	3.2
H	SOLISPA	*Solidago spathulata*	0.1	0.1	0.1	0.0	100.0	3.2
H	ARTECAM	*Artemisia campestris*	0.1	0.1	0.1	0.0	100.0	3.2
M	DICRPOL	*Dicranum polysetum*	0.1	0.0	0.1	0.1	50.0	1.6
H	LILIPHI	*Lilium philadelphicum*	0.1	0.0	0.1	0.1	50.0	1.6
S3	PRUNPEN	*Prunus pensylvanica*	0.0	0.1	0.1	0.1	50.0	1.6
M	POLYPIL	*Polytrichum piliferum*	0.1	0.0	0.1	0.1	50.0	1.6
L	PELTMAL	*Peltigera malacea*	0.1	0.0	0.1	0.1	50.0	1.6
H	EQUILAE	*Equisetum laevigatum*	0.0	0.1	0.1	0.1	50.0	1.6
G	ELYMINN	*Leymus innovatus*	0.0	0.1	0.1	0.1	50.0	1.6
S3	RUBUIDA	*Rubus idaeus*	0.0	0.1	0.1	0.1	50.0	1.6
L	CLADONI	*Cladonia* spp.	0.1	0.0	0.1	0.1	50.0	1.6
S2	POPUTRE	*Populus tremuloides*	0.0	0.1	0.1	0.1	50.0	1.6
G	CAREUMB	*Carex umbellata*	0.0	0.1	0.1	0.1	50.0	1.6
G	CAREDEW	*Carex deweyana*	0.1	0.0	0.1	0.1	50.0	1.6
M	MOSS$$$	*Unidentified Mosses*	0.0	0.1	0.1	0.1	50.0	1.6
H	ARABHOL	*Arabis holboellii*	0.0	0.1	0.1	0.1	50.0	1.6
H	EQUIHYE	*Equisetum hyemale*	0.1	0.0	0.1	0.1	50.0	1.6
L	PELTIGE	*Peltigera* sp.	0.0	0.1	0.1	0.1	50.0	1.6
S2	PRUNVIR	*Prunus virginiana*	0.0	0.1	0.1	0.1	50.0	1.6
H	ARABDIV	*Arabis divaricarpa*	0.1	0.0	0.1	0.1	50.0	1.6
H	GENTAMA	*Gentianella amarella*	0.0	0.1	0.1	0.1	50.0	1.6
S2	SALIBEB	*Salix bebbiana*	0.0	0.1	0.1	0.1	50.0	1.6
L	PELTCAN	*Peltigera canina*	0.1	0.0	0.1	0.1	50.0	1.6
H	FRAGVIR	*Fragaria virginiana*	0.1	0.0	0.1	0.1	50.0	1.6
H	ACHIMIL	*Achillea millefolium*	0.1	0.0	0.1	0.1	50.0	1.6

Allen and Johnson (no date.) described a *Pinus banksiana / Alnus crispa* community from the Richardson River Dunes Wildland Park. Here it was found at the base of dune ridges.

NatureServe (2004) lists a *Pinus banksiana - Populus tremuloides / Diervilla lonicera* Forest (CEGL002518) that was found in Minnesota, Ontario, and possibly Quebec and Manitoba. This type occupies level sandy outwash plains or moderately sloping moraines. Stands were generally mixed and dominated by *Pinus banksiana* and *Populus tremuloides* with some *Abies balsamea, Betula papyrifera, Picea glauca*, and *Picea mariana*. Conifers tend to be more abundant in the northern parts of the range (Sims *et al.* 1989, Zoladeski *et al.* 1995). The shrub layer was well developed and included *Corylus cornuta, Diervilla lonicera, Linnaea borealis, Rosa acicularis, Rubus pubescens*, and *Vaccinium* spp. The herb layer was diverse and consisted of *Aralia nudicaulis, Eurybia macrophylla (= Aster macrophyllus), Cornus canadensis, Clintonia borealis, Streptopus lanceolatus var. longipes (= Streptopus roseus), Trientalis borealis, Viola* spp., and other species. Similarity ratings for related plant community types are provided in Table 6.

Table 6. Correlation table of plant community types with similarity ratings for the *Pinus banksiana / Alnus viridis - Vaccinium myrtilloides / Oryzopsis pungens* type.

Similar Types	**Similarity Rating**	**Comments**
Pinus banksiana / Arctostaphylos uva-ursi / Cladina spp. CT (Nelson *et al.* 1989)	2(3)	A similar community type that occupies similar ecological niche in the Holmes Crossing Sandhills Ecological Reserve.
Pinus banksiana – Populus tremuloides / Linnaea borealis - Vaccinium vitis-idaea CT (Nelson *et al.* 1989)	3	Although *Populus tremuloides* was co-dominant in the overstorey this type has similar species composition. There are however, considerable differences in species dominance between these two types.
Pinus banksiana / Arctostaphylos uva-ursi / Oryzopsis pungens CT (Timoney and Robinson 1998)	2	The current classification was likely related to the forest component of this type, however, no *Alnus viridis* was mentioned for this type and additional details regarding the floristics were required to make a direct comparison.
Pinus banksiana / Alnus crispa CT (Allen and Johnson no date)	3	Same dominant tree and shrub but no further details were provided for this type to allow a better comparison.
Pinus banksiana - Populus tremuloides / Diervilla lonicera Forest (CEGL002518) (NatureServe 2004)	3	This type appears to occupy sites with similar ecological conditions. However, stands were mixed and there were considerable differences in floristics. This community included many eastern species.

Plate 2. *Pinus banksiana / Vaccinium spp. / Pleurozium schreberi* Forest (P43).

Plate 3. *Pinus banksiana / Alnus viridis / Oryzopsis pungens* Forest (P21).

3.3.1.3 *Pinus banksiana / Arctostaphylos uva-ursi / Apocynum androsaemifolium* Forest

Jack Pine / Common Bearberry / Spreading Dogbane Forest

This plant community was not encountered in the North Buck Lake study area but two samples were completed in the Holmes Crossing Sandhills Ecological Reserve where it was relatively common. It typically occurred on south facing upper slopes and crests of dunes. Soils consist of fine sands that were well to rapidly drained and had subxeric to submesic moisture levels with a mesotrophic nutrient regime. Moderate levels of insolation affected sites. The surface substrate cover consisted of organic matter (94%), mineral soil (3%), and decaying wood (1%). The overstorey canopy was quite open, averaging 23% closure consisting of *Pinus banksiana* and scattered *Populus tremuloides* trees (Table 7). The shrub layer consisted of scattered *Alnus viridis* with less than 11% cover. Constant species diagnostic of this community include *Apocynum androsaemifolium* and *Arctostaphylos uva-ursi* at 7% and 45% mean cover, respectively. Other shrubs associated with this type include *Amelanchier alnifolia, Rosa acicularis* and *Prunus virginiana. Usnea* spp. was present in both plots and averaged 33% cover. Common forbs included *Lathyrus ochroleucus, Smilacina stellata, Lilium philadelphicum, Smilacina stellata, Maianthemum canadense, Solidago spathulata, Galium boreale, Anemone multifida Astragalus striatus,* and *Aster laevis*. Graminoids associated with this type include *Oryzopsis pungens Carex umbellata* and *Elymus trachycaulus.*

Class: Forest
Subclass: Evergreen forest
Group: Temperate or subpolar needle-leaved evergreen forest
Subgroup: Natural/Semi-natural
Formation: Rounded-crowned temperate or subpolar needle-leaved evergreen forest
Alliance: *Pinus banksiana* Forest
Association: *Pinus banksiana / Arctostaphylos uva-ursi / Apocynum androsaemifolium* Forest
Unique Identifier: n/a
Classification Confidence Level: 3 (Weak) Although this community appeared to be relatively common in the Holmes Crossing area there were only two plots completed and no reference to this type was located literature. The geographic distribution of this community was unknown.

Dominant Species: *Pinus banksiana, Alnus viridis, Arctostaphylos uva-ursi, Apocynum androsaemifolium, Usnea* spp.
Co-Dominant Species: *Populus tremuloides, Amelanchier alnifolia, Rosa acicularis, Lathyrus ochroleucus, Smilacina stellata, Oryzopsis pungens*
Diagnostic Species: *Pinus banksiana, Alnus viridis, Amelanchier alnifolia, Arctostaphylos uva-ursi, Apocynum androsaemifolium, Lilium philadelphicum, Carex umbellata*

Literature Review:

Nelson *et al.* (1989) described a *Pinus banksiana / Arctostaphylos uva-ursi / Cladina mitis* community occurring in the Holmes Crossing area. It was similar to the current type but does not have any *Apocynum androsaemifolium* cover.

Raup and Argus (1982) provide a broad description of a *Pinus banksiana* forest in the Lake Athabasca area that often included *Picea mariana* and *Betula papyrifera,* as co-dominants. Common shrub species included *Alnus crispa, Salix scouleriana, Viburnum edule, Ledum groenlandicum, Empetrum nigrum, Arctostaphylos uva-ursi,* and *Vaccinium vitis-idaea.* Common herb layer species included *Lycopodium annotinum, L. sitchense, Goodyera repens, Lathyrus ochroleucus, Vicia americana, Cornus canadensis, Apocynum androsaemifolium,* and *Melampyrum lineare.*

Table 7. Summary of plot data and descriptive statistics for the *Pinus banksiana / Arctostaphylos uva-ursi / Apocynum androsaemifolium* community type (n=2).

			Plots					
Strata	**Code**	**Species**	**P26**	**P28**	**Mean**	**SE**	**Constancy**	**Prominence**
S3	ARCTUVA	*Arctostaphylos uva-ursi*	30.0	60.0	45.0	15.0	100.0	67.1
E	USNEA$$$	*Usnea* spp.	60.0	5.0	32.5	27.5	100.0	57.0
T1	PINUBAN	*Pinus banksiana*	25.0	20.0	22.5	2.5	100.0	47.4
E	EPIPHYT	*Epiphyte* spp.	10.0	5.0	7.5	2.5	100.0	27.4
S1	ALNUVIR	*Alnus viridis*	3.0	10.0	6.5	3.5	100.0	25.5
H	APOCAND	*Apocynum androsaemifolium*	8.0	5.0	6.5	1.5	100.0	25.5
S3	AMELALN	*Amelanchier alnifolia*	5.0	1.0	3.0	2.0	100.0	17.3
T2	POPUTRE	*Populus tremuloides*	0.1	2.0	1.1	1.0	100.0	10.2
S3	ROSAACI	*Rosa acicularis*	2.0	0.1	1.1	1.0	100.0	10.2
G	ORYZPUN	*Oryzopsis pungens*	1.0	1.0	1.0	0.0	100.0	10.0
H	LATHOCH	*Lathyrus ochroleucus*	1.0	1.0	1.0	0.0	100.0	10.0
H	SMILSTE	*Smilacina stellata*	1.0	1.0	1.0	0.0	100.0	10.0
H	MAIACAN	*Maianthemum canadense*	0.1	1.0	0.6	0.5	100.0	7.4
H	SOLISPA	*Solidago spathulata*	1.0	0.1	0.6	0.5	100.0	7.4
H	GALIBOR	*Galium boreale*	1.0	0.1	0.6	0.5	100.0	7.4
S3	PRUNVIR	*Prunus virginiana*	1.0	0.1	0.6	0.5	100.0	7.4
T1	POPUTRE	*Populus tremuloides*	2.0	0.0	1.0	1.0	50.0	7.1
H	LILIPHI	*Lilium philadelphicum*	0.1	0.1	0.1	0.0	100.0	3.2
G	CAREUMB	*Carex umbellata*	0.1	0.1	0.1	0.0	100.0	3.2
H	ANEMMUL	*Anemone multifida*	0.1	0.1	0.1	0.0	100.0	3.2
H	ASTRSTR	*Astragalus striatus*	0.1	0.1	0.1	0.0	100.0	3.2
H	ASTELAE	*Aster laevis*	0.1	0.1	0.1	0.0	100.0	3.2
G	ELYMTRA	*Elymus trachycaulus*	0.1	0.1	0.1	0.0	100.0	3.2
S1	PINUBAN	*Pinus banksiana*	0.1	0.0	0.1	0.1	50.0	1.6
M	MOSS$$$	*Moss* spp.	0.0	0.1	0.1	0.1	50.0	1.6
S3	LINNBOR	*Linnaea borealis*	0.0	0.1	0.1	0.1	50.0	1.6
S3	VACCVIT	*Vaccinium vitis-idaea*	0.0	0.1	0.1	0.1	50.0	1.6
S3	RUBUIDA	*Rubus idaeus*	0.1	0.0	0.1	0.1	50.0	1.6
G	ELYMINN	*Leymus innovatus*	0.1	0.0	0.1	0.1	50.0	1.6
L	CLADMIT	*Cladina mitis*	0.0	0.1	0.1	0.1	50.0	1.6
S3	SYMPOCC	*Symphoricarpos occidentalis*	0.0	0.1	0.1	0.1	50.0	1.6
H	HIERUMB	*Hieracium umbellatum*	0.0	0.1	0.1	0.1	50.0	1.6
H	ARTECAM	*Artemisia campestris*	0.1	0.0	0.1	0.1	50.0	1.6
S3	POPUTRE	*Populus tremuloides*	0.0	0.1	0.1	0.1	50.0	1.6
S3	PRUNPEN	*Prunus pensylvanica*	0.0	0.1	0.1	0.1	50.0	1.6
T2	PICEGLA	*Picea glauca*	0.1	0.0	0.1	0.1	50.0	1.6
G	CAREPEN	*Carex pensylvanica*	0.1	0.0	0.1	0.1	50.0	1.6
H	CAMPROT	*Campanula rotundifolia*	0.0	0.1	0.1	0.1	50.0	1.6
M	PLEUSCH	*Pleurozium schreberi*	0.1	0.0	0.1	0.1	50.0	1.6

NatureServe (2004) lists a *Pinus banksiana / Arctostaphylos uva-ursi* Forest (CEGL002438) that occurred in the midwestern United States and central Canada including Manitoba (Greenall 1996). This type has similarities in composition and structure but included species not found in the study areas and does not include *Apocynum androsaemifolium* as a diagnostic species. Similarity ratings for related plant community types are provided in Table 8.

Table 8. Correlation table of plant community types with similarity ratings for the *Pinus banksiana / Apocynum androsaemifolium - Arctostaphylos uva-ursi* type.

Similar Types	Similarity Rating	Comments
Pinus banksiana / Arctostaphylos uva-ursi / Cladina mitis CT (Nelson *et al.* 1989)	3(2)	Similar dominant species in this type but *Cladina mitis* cover was higher and *Apocynum androsaemifolium* was not listed as an important species.
Pinus banksiana Forest (Raup and Argus 1982)	2	Slightly moister Lake Athabasca dune community but included many of the same plant species. *Apocynum androsaemifolium* was present but there were no details available regarding percent covers.
Pinus banksiana / Arctostaphylos uva-ursi Forest (CEGL002438) (NatureServe 2004)	3	Similar community but the description does not indicate that *Apocynum androsaemifolium* was a constant species.

3.3.1.4 *Pinus banksiana / Vaccinium vitis-idaea - Arctostaphylos uva-ursi* Forest
Jack Pine / Bog Cranberry - Common Bearberry Forest

This community was not common and only one (1) plot was completed for it in the North Buck Lake study area (Table 9). This site was located in a nearly level to slight depression. Soils were well drained with mesic moisture levels and a mesotrophic nutrient regime. The substrate cover consisted mainly of organic matter (98%) with decaying wood (2%) and a trace of mineral soil. This stand had a closed canopy of *Pinus banksiana* and no medium or tall shrub layers. Cover in the low shrub layer consisted of *Vaccinium vitis-idaea* (30%), *Vaccinium myrtilloides* (25%), *Arctostaphylos uva-ursi* (3%), and *Rosa acicularis* (1%). The herb/graminoid layer was sparse with less than 3% cover consisting of *Maianthemum canadense, Medicago lupulina, Oryzopsis pungens, Pyrola chlorantha, Schizachne purpurascens,* and *Hieracium umbellatum.* The moss layer had less than 17% cover consisting mainly of *Pleurozium schreberi. Cladina mitis* was present in trace amounts. This stand type may grade into a *Pinus banksiana / Arctostaphylos uva-ursi* Forest on drier sites or a *Pinus banksiana / Vaccinium myrtilloides - Vaccinium vitis-idaea / Pleurozium schreberi* Forest on moister sites.

Class: Forest
Subclass: Evergreen forest
Group: Temperate or subpolar needle-leaved evergreen forest
Subgroup: Natural/Semi-natural
Formation: Rounded-crowned temperate or subpolar needle-leaved evergreen forest
Alliance: *Pinus banksiana* Forest
Association: *Pinus banksiana / Vaccinium vitis-idaea - Arctostaphylos uva-ursi* Forest
Unique Identifier: n/a
Classification Confidence Level: 2 (Moderate) Only one plot was completed in this type and there was considerable variability in the published literature. Geographical distribution was uncertain.

Dominant Species: *Pinus banksiana, Vaccinium vitis-idaea, Arctostaphylos uva-ursi, Pleurozium schreberi*
Co-Dominant Species: *Rosa acicularis, Vaccinium myrtilloides, Maianthemum canadense, Cladina mitis, Usnea* spp
Diagnostic Species: *Pinus banksiana, Vaccinium vitis-idaea, Vaccinium myrtilloides, Arctostaphylos uva-ursi, Pleurozium schreberi*

Table 9. Summary of plot data and descriptive statistics for the *Pinus banksiana / Vaccinium vitis-idaea - Arctostaphylos uva-ursi* community type (n=1).

			Plot
Strata	**Code**	**Species**	**P41**
T1	PINUBAN	*Pinus banksiana*	40.0
S3	VACCVIT	*Vaccinium vitis-idaea*	30.0
S3	ARCTUVA	*Arctostaphylos uva-ursi*	25.0
M	PLEUSCH	*Pleurozium schreberi*	16.0
E	USNEA$$$	*Usnea* spp.	5.0
S3	VACCMYR	*Vaccinium myrtilloides*	3.0
L	CLADMIT	*Cladina mitis*	1.0
H	MAIACAN	*Maianthemum canadense*	1.0
S3	ROSAACI	*Rosa acicularis*	1.0
H	MELALIN	*Medicago lupulina*	0.1
G	ORYZPUN	*Oryzopsis pungens*	0.1
S3	PRUNPEN	*Prunus pensylvanica*	0.1
M	PTILCRI	*Ptilium crista-castrensis*	0.1
M	POLYPIL	*Polytrichum piliferum*	0.1
M	DICRPOL	*Dicranum polysetum*	0.1
H	PYROCHL	*Pyrola chlorantha*	0.1
H	CAMPROT	*Campanula rotundifolia*	0.1
G	SCHIPUR	*Schizachne purpurascens*	0.1
L	CLADGRA	*Cladonia gracilis*	0.1
H	HIERUMB	*Hieracium umbellatum*	0.1
S3	PINUBAN	*Pinus banksiana*	0.1
S1	PINUBAN	*Pinus banksiana*	0.1

Literature Review:

Allen *et al.* (2003) reported a *Pinus banksiana / Vaccinium vitis-idaea / Cladonia* spp. community type that occurred in the Fidler-Greywillow Provincial Park at Lake Athabasca. It was widespread on stabilised dunes and sandy plains, and was considered an early stage of the *Pinus banksiana / Cladina* spp. type.

Beckingham and Archibald (1996) identified a *Pinus banksiana - Populus tremuloides / Vaccinium myrtilloides - Arctostaphylos uva-ursi* forest (b1.1) for the boreal mixedwood. This community was similar to the current type but *Populus tremuloides*, and *P. mariana* were co-dominant in the overstorey and *Picea glauca* was present in the shrub layer. There was also greater cover of *Vaccinium myrtilloides* and *Cladina* spp. in the b1.1 type. Another difference was the absence of *Leymus innovatus* and *Hylocomium splendens* in the North Buck Lake plot. Beckingham and Archibald (1996) also described a *Pinus banksiana / Arctostaphylos uva-ursi / Cladina mitis* plant community type (a.1.1). This boreal mixedwood type was similar to the current type but has higher cover of *Arctostaphylos uva-ursi* (≥20%) in contrast to trace amounts found in the current type. Otherwise cover of other the dominant and diagnostic species was similar.

Alberta Energy and Natural Resources (1978a, 1978b) reported a *Pinus banksiana / Arctostaphylos uva-ursi* forest occurred in the Wapiti – Grande Prairie sand dunes area. This type occurred on fine to medium sandy soils that were rapidly drained. No additional details regarding plant composition were provided.

NatureServe (2004) lists a *Pinus banksiana / Arctostaphylos uva-ursi* Forest (CEGL002438) for the midwestern United States and central Canada, including Manitoba (Zoladeski *et al.* 1995). It occurred on eolian, glaciofluvial, lacustrine, and morainal deposits. Soils were typically sand, loamy sand, or sandy loam. The overstorey consisted of *Pinus banksiana* with some *Pinus resinosa, Populus tremuloides,* and *Picea mariana* in stands adjacent to wet areas. The shrub layer included *Amelanchier alnifolia, Arctostaphylos uva-ursi, Diervilla lonicera, Hudsonia tomentosa*, and *Vaccinium* spp. Herbs consist of *Aster laevis, Cornus canadensis, Maianthemum canadense, Oryzopsis asperifolia*, and *Solidago* spp. In the absence of fire these stands may succeed to *Abies balsamea, Picea glauca* and *Picea mariana.* Mosses were common on mesic sites. A related mixed stand type was the *Pinus banksiana - Populus tremuloides - Picea mariana / Pleurozium schreberi* Forest (CEGL002519) was ranked GNR. This type occurred in Manitoba (Greenall 1996) and Ontario (Sims *et al.* 1989) but no details were available for this review. Similarity ratings for related plant community types are provided in Table 10.

Table 10. Correlation table of plant community types with similarity ratings for the *Pinus banksiana / Vaccinium vitis-idaea - Arctostaphylos uva-ursi* type.

Similar Types	Similarity Rating	Comments
Pinus banksiana/Vaccinium vitis-idaea/Cladonia CT(Allen *et al.* 2003)	2	Similar type although it appears that *Arctostaphylos uva-ursi* cover was lower and *Cladonia gracilis* cover was much higher in this type.
Pinus banksiana - Populus tremuloides / Vaccinium myrtilloides - Arctostaphylos uva-ursi CT (b1.1) (Beckingham and Archibald 1996)	2	Overstorey was more mixed and included *Populus tremuloides* and *Picea mariana* in this type. Dwarf shrub layer was similar but *Vaccinium myrtilloides* cover was greater.
Pinus banksiana / Arctostaphylos uva-ursi / Cladina spp. CT (a.1.1) (Beckingham and Archibald 1996)	2(3)	Similar but much more *Cladina* spp., *Vaccinium vitis-idaea* was not a dominant species, and *Pleurozium schreberi* had less cover in this type.
Pinus banksiana / Arctostaphylos uva-ursi Forest (CEGL002438) (Zoladeski *et al.* 1995, NatureServe 2004)	3(2)	Similar type but may be drier and does not appear to have significant cover of Vaccinium *vitis-idaea*. Included eastern species not native to Alberta.
Pinus banksiana - Populus tremuloides - Picea mariana / Pleurozium schreberi Forest (CEGL002519) (NatureServe 2004, Sims *et al.* 1989)	3	Similar type but no details were available for review.

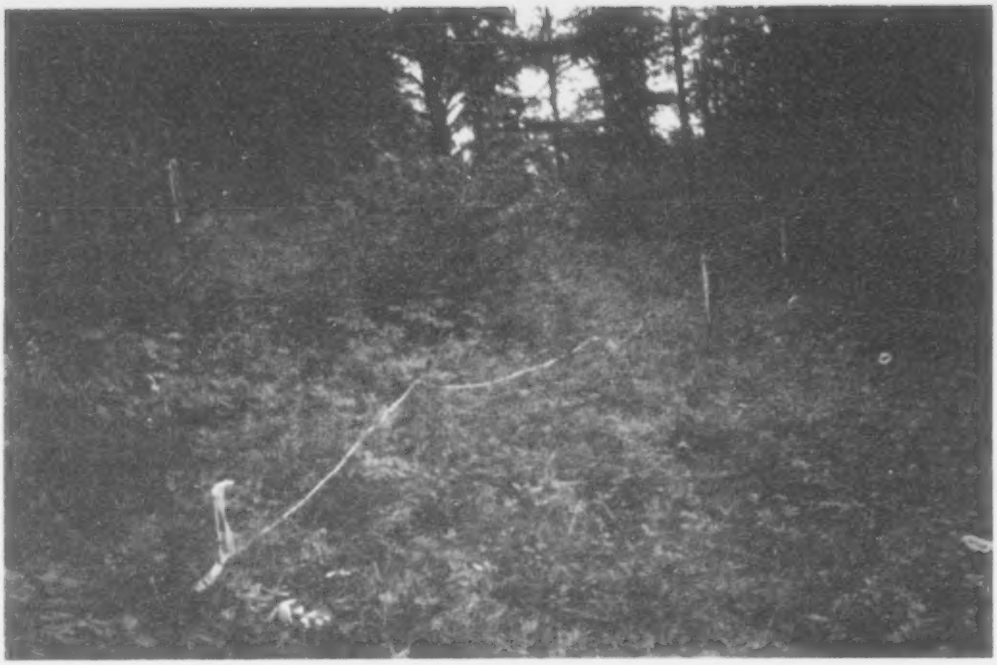


Plate 4. *Pinus banksiana / Arctostaphylos uva-ursi / Apocynum androsaemifolium* Forest (P26).

Plate 5. *Pinus banksiana / Vaccinium vitis-idaea - Arctostaphylos uva-ursi* Forest (P41).

3.3.1.5 *Pinus banksiana / Cladina mitis* Forest

Jack Pine – Reindeer Lichen Forest

The *Pinus banksiana / Cladina mitis* Forest was a very distinctive stand with usually 60% to 70% percent ground cover of *Cladina* spp. This community was sampled in both study areas but was encountered more frequently in the North Buck Lake study area (Table 11). Stands were located typically in crest to level site positions that commonly had convex to straight profiles with minimal slope gradients (3-10%). The sandy soils were well to rapidly drained with subxeric moisture conditions, and a mesotrophic nutrient regime. Surface substrate cover was predominately organic matter with some exposed soil (1-10%), and traces of decaying wood. The overstorey was dominated by *Pinus banksiana* with 20% to 40% canopy closure. There was no medium or tall shrub layer and the low shrub layer had less than 5% cover consisting of *Vaccinium myrtilloides, Arctostaphylos uva-ursi, Rosa acicularis,* and *Pinus banksiana.* The herb/graminoid layer was sparse and species with high constancy included *Maianthemum canadense, Medicago lupulina, Solidago spathulata,* and *Oryzopsis pungens.* Other important species included *Hudsonia tomentosa* and *Campanula rotundifolia.* Mosses with high constancy included *Polytrichum piliferum* and *Pohlia nutans.* The most common lichens were *Cladina mitis,Cladonia gracilis* and a variety of *Cladonia* spp.

Class: Forest
Subclass: Evergreen forest
Group: Temperate or subpolar needle-leaved evergreen forest
Subgroup: Natural/Semi-natural
Formation: Rounded-crowned temperate or subpolar needle-leaved evergreen forest
Alliance: *Pinus banksiana* Forest
Association: *Pinus banksiana / Cladina mitis* Forest
Unique Identifier: n/a
Classification Confidence Level: 1 (Strong) This was very distinctive type and that was relatively well documented in the literature. Appears to be widespread throughout the boreal region but exact geographic range was uncertain.

Dominant Species: *Pinus banksiana, Cladina mitis*
Co-Dominant Species: *Vaccinium vitis-idaea, Vaccinium myrtilloides, Maianthemum canadense, Polytrichum piliferum, Cladonia gracilis*
Diagnostic Species: *Pinus banksiana, Cladina mitis, Arctostaphylos uva-ursi, Maianthemum canadense, Medicago lupulina, Solidago spathulata, Oryzopsis pungens*

Literature Review:

The *Pinus banksiana / Cladina mitis* community type was similar to the *Pinus banksiana / Arctostaphylos uva-ursi / Cladina mitis* community type described by Nelson *et al.* (1989). This latter type occurred on sand plains and dunes in the Holmes Crossing study area. The plant community composition of this type was similar, however, the percent cover of *Arctostaphylos uva-ursi* was a higher and *Cladina mitis* cover was significantly lower.

Allen *et al.* (2003) reported a *Pinus banksiana / Vaccinium myrtilloides / Cladina mitis* community type from the Fidler-Greywillow Provincial Park at Lake Athabasca. It was recognised as a widespread type that occurred on stabilised dunes and sandy dunes. Allen *et al.* (2002) reported a *Pinus banksiana / Arctostaphylos uva-ursi* community type from the La Butte Creek Provincial Park in northeastern Alberta. It typically had significant lichen cover and occurred as small stands on flatter sites among outcrops.

Table 11. Summary of plot data and descriptive statistics for the *Pinus banksiana / Cladina mitis* community type (n=3).

			Plots						
Strata	**Code**	**Species**	**P06**	**P40**	**P42**	**Mean**	**SE**	**Constancy**	**Prominence**
L	CLADMIT	*Cladina mitis*	70.0	70.0	60.0	66.7	3.3	100.0	81.6
T1	PINUBAN	*Pinus banksiana*	20.0	38.0	40.0	32.7	6.4	100.0	57.2
E	USNEA$$$	*Usnea* spp.	0.0	25.0	0.0	8.3	8.3	33.3	16.7
M	PLEUSCH	*Pleurozium schreberi*	15.0	0.0	0.0	5.0	5.0	33.3	12.9
H	MAIACAN	*Maianthemum canadense*	3.0	0.1	0.1	1.1	1.0	100.0	10.3
S3	VACCVIT	*Vaccinium vitis-idaea*	9.0	0.0	0.0	3.0	3.0	33.3	10.0
S3	VACCMYR	*Vaccinium myrtilloides*	4.0	0.1	0.0	1.4	1.3	66.7	9.5
L	CLADGRA	*Cladonia gracilis*	0.1	3.0	0.0	1.0	1.0	66.7	8.3
S1	PINUBAN	*Pinus banksiana*	0.0	1.0	2.0	1.0	0.6	66.7	8.2
E	EPIPHYT	*Epiphyte* spp.	0.0	5.0	0.0	1.7	1.7	33.3	7.5
S3	ARCTUVA	*Arctostaphylos uva-ursi*	1.0	0.1	0.1	0.4	0.3	100.0	6.3
M	POLYPIL	*Polytrichum piliferum*	0.0	0.1	1.0	0.4	0.3	66.7	4.9
S3	ROSAACI	*Rosa acicularis*	1.0	0.0	0.0	0.3	0.3	33.3	3.3
S3	PINUBAN	*Pinus banksiana*	0.1	0.1	0.1	0.1	0.0	100.0	3.2
G	ORYZPUN	*Oryzopsis pungens*	0.1	0.1	0.1	0.1	0.0	100.0	3.2
H	SOLISPA	*Solidago spathulata*	0.1	0.1	0.1	0.1	0.0	100.0	3.2
H	MELALIN	*Medicago lupulina*	0.1	0.1	0.1	0.1	0.0	100.0	3.2
H	HUDSTOM	*Hudsonia tomentosa*	0.0	0.1	0.1	0.1	0.0	66.7	2.1
M	POHLNUT	*Pohlia nutans*	0.1	0.1	0.0	0.1	0.0	66.7	2.1
H	CAMPROT	*Campanula rotundifolia*	0.1	0.0	0.1	0.1	0.0	66.7	2.1
M	DICRPOL	*Dicranum polysetum*	0.0	0.0	0.1	0.0	0.0	33.3	1.1
H	ANEMMUL	*Anemone multifida*	0.1	0.0	0.0	0.0	0.0	33.3	1.1
M	PTILCRI	*Ptilium crista-castrensis*	0.1	0.0	0.0	0.0	0.0	33.3	1.1
S3	PICEGLA	*Picea glauca*	0.1	0.0	0.0	0.0	0.0	33.3	1.1
H	HIERUMB	*Hieracium umbellatum*	0.1	0.0	0.0	0.0	0.0	33.3	1.1
H	ARTECAM	*Artemisia campestris*	0.0	0.1	0.0	0.0	0.0	33.3	1.1
H	VIOLADU	*Viola adunca*	0.1	0.0	0.0	0.0	0.0	33.3	1.1
G	AGROSCA	*Agrostis scabra*	0.0	0.0	0.1	0.0	0.0	33.3	1.1
L	CLADDEF	*Cladonia deformis*	0.0	0.1	0.0	0.0	0.0	33.3	1.1
L	CLADCOR	*Cladonia cornuta*	0.1	0.0	0.0	0.0	0.0	33.3	1.1
L	CLADCAR	*Cladonia cariosa*	0.1	0.0	0.0	0.0	0.0	33.3	1.1
L	CLADBEL	*Cladonia bellidiflora*	0.0	0.1	0.0	0.0	0.0	33.3	1.1
S2	PRUNPEN	*Prunus pensylvanica*	0.0	0.1	0.0	0.0	0.0	33.3	1.1
S3	AMELALN	*Amelanchier alnifolia*	0.1	0.0	0.0	0.0	0.0	33.3	1.1
H	EQUIHYE	*Equisetum hyemale*	0.1	0.0	0.0	0.0	0.0	33.3	1.1
H	ASTELAE	*Aster laevis*	0.1	0.0	0.0	0.0	0.0	33.3	1.1
G	ELYMINN	*Leymus innovatus*	0.1	0.0	0.0	0.0	0.0	33.3	1.1
L	PELTCAN	*Peltigera canina*	0.1	0.0	0.0	0.0	0.0	33.3	1.1
H	GALIBOR	*Galium boreale*	0.1	0.0	0.0	0.0	0.0	33.3	1.1

Allen and Johnson (no date.) and Meijer (2002c) described a *Pinus banksiana / Cladina mitis* type from the Marguerite River Wildland Park. This was considered to be a common plant community in northeastern Alberta. Stands occur on sandy area with rapidly drained soils and xeric moisture conditions. The shrub and herb layers were sparse or limited to a few denser patches of *Vaccinium myrtilloides* and scattered *Picea glauca*. Meijer (2002c) found this type to be most common on exposed crests with convex surface profiles. *Arctostaphylos uva-ursi* and *Hudsonia tomentosa* were both present in small amounts. Raup and Argus (1982) described a *Pinus banksiana* / lichen type that occurred on stabilised dunes and sandy till plains south of Lake Athabasca. In mature stands lichen mats formed that consisted of *Cladina arbuscula, C. mitis, C. rangiferina, C. stellaris, Cladonia amaurocraea* and *C. gracilis*. *Polytrichum juniperinum* and *P. piliferum* also formed pure mats or were intermixed with lichens. Common understorey vascular plants species included *Hudsonia tomentosa, Empetrum nigrum, Arctostaphylos uva-ursi*, and *Vaccinium myrtilloides*. Hermesh (1972) provided a brief description of a *Pinus banksiana / Cladina* spp. type that occurred in sheltered areas of the Lake Athabasca dunes. This community had scattered *Pinus banksiana* cover, with a dense mat of *Cladina rangiferina* and *C. mitis* mixed with patches of *Arctostaphylos uva-ursi*. Other species included *Betula papyrifera, Vaccinium myrtilloides* and *Cetraria* spp. Mackenzie River Basin Committee (1981) identified a *Pinus banksiana - Arctostaphylos uva-ursi* community at Lake Athabasca. This community was very similar to the other types described above.

Beckingham and Archibald (1996) identified a *Pinus banksiana / Arctostaphylos uva-ursi / Cladina mitis* plant community type (a.1.1). This boreal mixedwood type was very similar to the current type with exception that was has a higher content of *Arctostaphylos uva-ursi* (≥20%) as opposed to trace amounts in the current classification. Otherwise cover of other the dominant and diagnostic species were similar.

NatureServe (2004) lists a *Pinus banksiana* / Lichens Woodland (CEGL002522) that was ranked as GNR. This community was a Manitoba CDC classification (Greenall 1996) but according to NatureServe (2004) it needs "rangewide review". It was part of the *Pinus (banksiana, resinosa)* Woodland Alliance but no details were provided regarding floristics. Similarity ratings for related plant community types are provided in Table 12.

Table 12. Correlation table of plant community types with similarity ratings for the *Pinus banksiana / Cladina mitis* community type.

Similar Types	Similarity Rating	Comments
Pinus banksiana / Arctostaphylos uva-ursi / Cladina mitis CT (Nelson *et al.* 1989).	2	Related type but it has much higher cover of *Arctostaphylos uva-ursi* and much lower cover of *Cladina mitis*.
Pinus banksiana / Vaccinium myrtilloides / Cladina mitis CT (Allen *et al.* 2003)	3	No details were available but it appears to have higher cover of *Vaccinium myrtilloides*.
Pinus banksiana / Arctostaphylos uva-ursi CT (Allen *et al.* 2002)	2(1)	A related type but no details were available for further comparison.
Pinus banksiana / Cladina mitis CT (Allen and Johnson no date, Meijer 2002c)	1	Based on the plot data this would appear to be the same community type.
Pinus banksiana / Heath CT (Mackenzie River Basin Comm. 1981)	2(1)	Very similar type occurring on similar sites. Appears to have higher cover of *Arctostaphylos uva-ursi*.
Pinus banksiana / lichen CT (Raup and Argus 1982)	1(2)	Very similar or possibly identical type. Plants species list for the type was large and may include other community types based on the scale used for description.
Pinus banksiana / Cladina spp. CT Hermesh (1972)	1	Quite similar type with high cover of *Cladina* spp. and scattered *Pinus banksiana*.
Pinus banksiana / Arctostaphylos uva-ursi / Cladina mitis CT (a.1.1). (Beckingham and Archibald 1996)	2(1)	Very similar type occurring on similar sites. Main difference was the higher cover of *Arctostaphylos uva-ursi* in this type.
Pinus banksiana / Lichens Woodland (CEGL002522) (NatureServe 2004)	2	Appears to be a very closely related type but more details were required regarding the floristics.

3.3.1.6 *Picea glauca - Picea mariana / Rosa acicularis / Cornus canadensis* Forest
White Spruce – Black Spruce / Prickly Rose / Bunchberry Forest

White spruce stands were not common within either study area and only one plot was completed in the Holmes Crossing Sandhills Ecological Reserve (Table 13). This was a small stand located on a small northeast-facing slope adjacent to a stream and beaver pond. Soils were well drained with mesic moisture levels and a mesotrophic nutrient regime. The surface substrate cover consisted mostly of organic matter (94%) and decaying wood (4%). The overstorey cover consisted of *Picea glauca* (40%) and *Picea mariana* (20%). The shrub layer was open and included *Rosa acicularis* (3%), *Cornus canadensis* (3%), *Vaccinium myrtilloides* (2%), and trace amounts of *Betula papyrifera, Rubus idaeus, Prunus pensylvanica,* and *Viburnum edule.* The herbaceous layer was quite diverse but all species occurred at 1% or less cover. These included *Aralia nudicaulis, Fragaria virginiana, Rubus pubescens, Equisetum scirpoides Aster laevis Pyrola chlorantha, Geocaulon lividum, Maianthemum canadense, Orthilia secunda, Linnaea borealis, Pyrola asarifolia, Equisetum pratense, Equisetum arvense, Aster conspicuus, Leymus innovatus,* and *Viola renifolia.* Moss cover consisted of *Brachythecium salebrosum* (10%), *Ptilium crista-castrensis* (2%), *Hylocomium splendens* (1%), and trace *Pleurozium schreberi.*

Class: Forest
Subclass: Evergreen Forest
Group: Temperate or subpolar needle-leaved evergreen forest
Subgroup: Natural/Semi-natural temperate or subpolar needle-leaved evergreen forest
Formation: Conical-crowned temperate or subpolar needle-leaved evergreen forest
Alliance: *Picea glauca- Picea mariana* Forest Alliance (***Proposed***)
Association: *Picea glauca - Picea mariana / Rosa acicularis / Cornus canadensis* Forest
Unique Identifier: n/a
Classification Confidence Level: 3 (Weak) Only one plot completed in a small stand and this community type was not well documented in the literature. Geographical range was unknown.

Dominant Species: *Picea glauca, Picea mariana, Cornus canadensis, Rosa acicularis*
Co-Dominant Species: *Vaccinium myrtilloides, Aralia nudicaulis, Fragaria virginiana, Rubus pubescens, Brachythecium salebrosum, Ptilium crista-castrensis, Hylocomium splendens*
Diagnostic Species: *Picea glauca, Picea mariana, Rosa acicularis, Cornus canadensis, Brachythecium salebrosum*

Literature Review:

Picea mariana was common in this stand and in this classification it was placed under a new alliance named the *Picea glauca - Picea mariana* Forest Alliance. No *Abies balsamea* was recorded in this community but it may be expected to be part of more climax stands and therefore may be part of the *Picea glauca - Abies balsamea* Forest Alliance.

Timoney and Robinson (1998) noted a *Picea glauca / Cornus stolonifera / Viburnum edule / Equisetum pratense* / feather moss type in the Ft. Assiniboine Sandhills Wildland Park. This was an old growth riparian type.

Allen and Johnson (no date.) described a *Picea glauca / Viburnum edule – Rosa acicularis* community type from the Richardson River Dunes Wildland Park. This mature forest had an understorey dominated by *Viburnum edule* and *Rosa acicularis,* and feather moss. Another type was described as a *Picea glauca / Viburnum edule / Hylocomium splendens - Pleurozium schreberi* community that was found along an old river channel. It had relatively high of Abies *balsamea* in understorey.

Table 13. Summary of plot data and descriptive statistics for the *Picea glauca - Picea mariana / Rosa acicularis / Cornus canadensis* community type (n=1).

			Plot
Strata	**Code**	**Species**	**P19**
T1	PICEGLA	*Picea glauca*	40.0
T1	PICEMAR	*Picea mariana*	20.0
M	BRACSAL	*Brachythecium salebrosum*	10.0
T2	PICEMAR	*Picea mariana*	5.0
S3	RUBUPUB	*Rubus pubescens*	3.0
S3	CORNCAN	*Cornus canadensis*	3.0
S3	ROSAACI	*Rosa acicularis*	3.0
M	PTILCRI	*Ptilium crista-castrensis*	2.0
S3	VACCMYR	*Vaccinium myrtilloides*	2.0
H	ARALNUD	*Aralia nudicaulis*	1.0
H	FRAGVIR	*Fragaria virginiana*	1.0
M	HYLOSPL	*Hylocomium splendens*	1.0
E	EPIPHYT	*Epiphyte* spp.	0.1
H	LYCOANN	*Lycopodium annotinum*	0.1
H	EQUISCI	*Equisetum scirpoides*	0.1
H	ASTELAE	*Aster laevis*	0.1
M	PLEUSCH	*Pleurozium schreberi*	0.1
S3	BETUPAP	*Betula papyrifera*	0.1
H	PYROCHL	*Pyrola chlorantha*	0.1
H	PETASAG	*Petasites frigidus var sagittatus*	0.1
H	LATHOCH	*Lathyrus ochroleucus*	0.1
H	GEOCLIV	*Geocaulon lividum*	0.1
H	MAIACAN	*Maianthemum canadense*	0.1
H	ORTHSEC	*Orthilia secunda*	0.1
H	GALIBOR	*Galium boreale*	0.1
S3	LINNBOR	*Linnaea borealis*	0.1
H	PYROASA	*Pyrola asarifolia*	0.1
H	EQUIPRA	*Equisetum pratense*	0.1
H	CAMPROT	*Campanula rotundifolia*	0.1
S3	RUBUIDA	*Rubus idaeus*	0.1
S3	VACCVIT	*Vaccinium vitis-idaea*	0.1
H	ASTECON	*Aster conspicuus*	0.1
S3	VIBUEDU	*Viburnum edule*	0.1
G	ELYMINN	*Leymus innovatus*	0.1
S3	PRUNPEN	*Prunus pensylvanica*	0.1
H	EQUIARV	*Equisetum arvense*	0.1
H	VIOLREN	*Viola renifolia*	0.1

Beckingham and Archibald (1996) described a *Picea glauca / Viburnum edule* type (d3.3) that was found in the boreal mixedwood. This community was very similar to the current type although percent cover of dominants and diagnostic species varied. The main differences in composition were the presence of *Populus tremuloides* and *Populus balsamifera* in the overstorey and *Mertensia paniculata* in the herb layer of this type. *Viburnum edule* was recorded at trace cover in the Holmes Crossing plot. These were considered relatively moderate to minor differences and may be more a function of small stand size and sample size. Another related type identified by Beckingham and Archibald (1996) was the *Picea glauca* / Feather moss community (d3.5). This type shares similar site characteristics and species composition. All species recorded in the Holmes Crossing type were included as indicator species for this type with the exception of *Populus balsamifera*. Also *Picea mariana* was a co-dominant in the overstorey at Holmes Crossing but was not included as an important species in this type.

No similar *Picea glauca* Associations were listed by NatureServe (2004) although they do described a *Picea mariana / Pleurozium schreberi* Forest (CEGL002447) that has some similar characteristics. This type occurred in Quebec, Ontario, Manitoba (Greenall 1996, Sims *et al.* 1989) and adjacent areas in the midwest United States. It was found on level to gently sloping ground where the soils were moderately well-drained, coarse loams, sands, and silts. The closed canopy was dominated by *Picea mariana* with some cover of *Abies balsamea, Betula papyrifera, Picea glauca, Pinus banksiana*, and *Populus tremuloides*. The shrub layer was thin consisting of *Corylus cornuta, Gaultheria procumbens, Ledum groenlandicum, Rosa acicularis, Vaccinium angustifolium*, and *Vaccinium myrtilloides*. The herb layer was sparse but may include *Eurybia macrophylla (= Aster macrophyllus), Cornus canadensis, Equisetum arvense*, and *Maianthemum canadense*. Feather moss cover was high and was dominated by *Pleurozium* *schreberi*. The main difference with the current classification was the lack of *Picea glauca* in this type and the higher cover of mosses. However, the plot completed in North Buck Lake study area was more well developed moss layer. Similarity ratings for related plant community types are provided in Table 14.

Table 14. Correlation table of plant community types with similarity ratings for *Picea glauca - Picea mariana / Rosa acicularis / Cornus canadensis* type.

Similar Types	Similarity Rating	Comments
Picea glauca / Cornus stolonifera / Viburnum edule / Equisetum pratense / feather moss (Timoney and Robinson 1998)	3	This may be a related type although no further details were available for comparing the two types.
Picea glauca / Viburnum edule – Rosa acicularis CT (Allen and Johnson no date)	2	Likely a similar type however more details were required about its species composition and site characteristics.
Picea glauca / Viburnum edule / Hylocomium splendens - Pleurozium schreberi CT (Allen and Johnson no date)	3	Possibly a similar type however more details were required about its species composition and site characteristics.
Picea glauca / Viburnum edule CT (d3.3) (Beckingham and Archibald 1996)	1(2)	This type occupies a similar ecological niche and has very similar floristics. Differences in composition were likely a function of the small stand size and lack of plots completed on the current study. *Picea mariana* was present at less than 2% cover in this CT.
Picea glauca / Feather moss CT (d3.5) (Beckingham and Archibald 1996)	2	A related type that was found in similar sites and has similar floristics. Again differences in composition may be function of the small stand size and sample size.
Picea mariana / Pleurozium schreberi Forest (CEGL002447) (NatureServe 2004)	3	Some similarity in species composition but there were important differences and it included a number of eastern species. Range may not extend into Alberta.

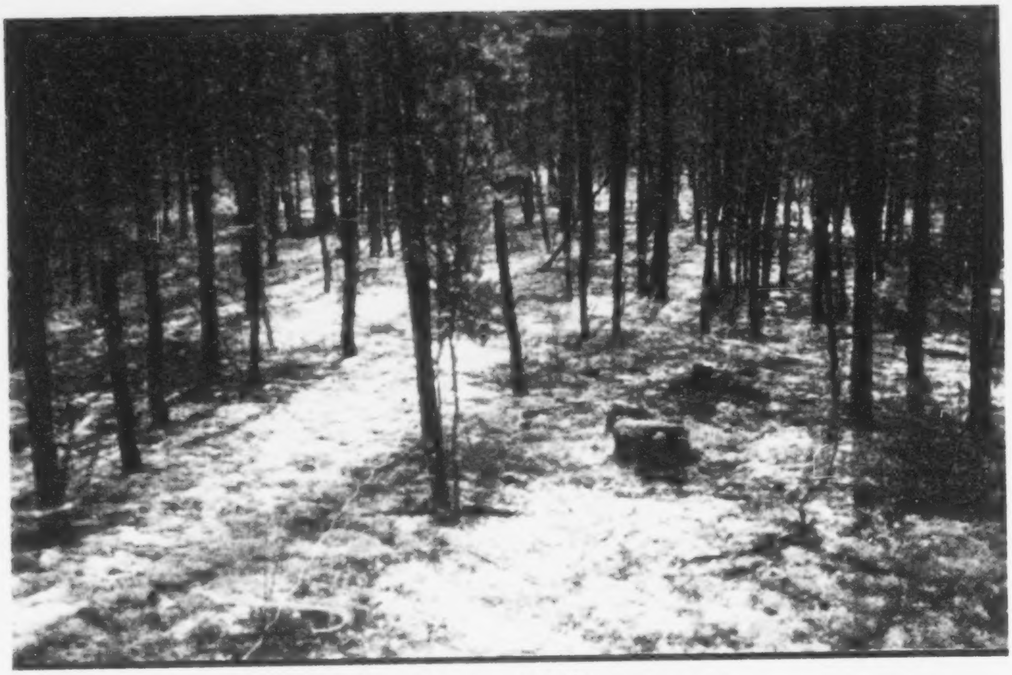


Plate 6. *Pinus banksiana / Cladina mitis* Forest (P40).

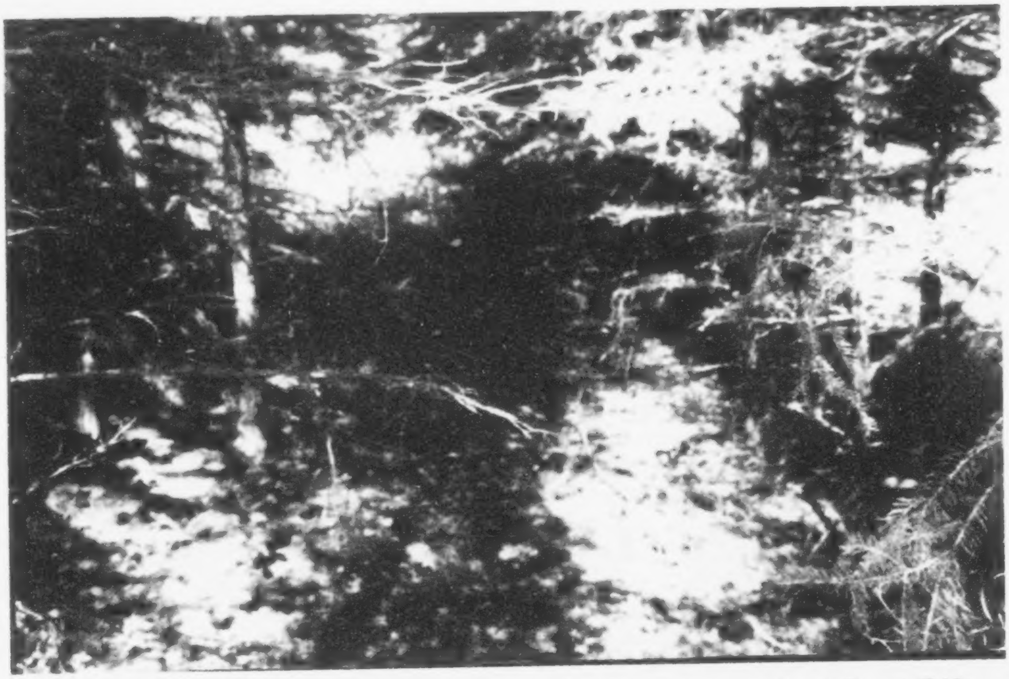


Plate 7. *Picea glauca - Picea mariana / Rosa acicularis / Cornus canadensis* Forest (P19).

3.3.1.7 *Picea glauca - Picea mariana / Ledum groenlandicum /Equisetum arvense* Forest
White Spruce - Black Spruce / Labrador Tea / Common Horsetail Forest

This community type was not common and only one stand was encountered. This site was in the North Buck Lake study area and was on a nearly level receiving site located at the base of a small knoll. Soils were moderately well drained with mesic moisture levels and a mesotrophic nutrient regime. The overstorey was closed and was dominated by *Picea glauca* (20%) and *Picea mariana* (25%) with trace amounts of *Populus tremuloides* and *Populus balsamifera* (Table 15). Dominant cover in the shrub layer consisted of *Alnus incana* spp. *tenuifolia* (5%), *Ledum groenlandicum* (3%), and *Vaccinium myrtilloides* (1%). The low shrub layer included trace amounts of *Abies balsamea, Linnaea borealis, Vaccinium vitis-idaea, Lonicera involucrata, Ribes triste, Picea glauca,* and *Populus balsamifera*. *Equisetum arvense* was the dominant herb at 60% cover. A variety of other herbs were present at trace to 2% cover values including *Petasites frigidus var sagittatus, Petasites frigidus var palmatus, Smilacina trifolia, Viola renifolia, Rubus arcticus, Scutellaria galericulata, Rubus pubescens,* and *Mitella nuda*. The moss layer was diverse and the dominant cover consisted of *Pleurozium schreberi* (20%), *Sphagnum magellanicum* (5%), *Aulacomnium palustre* (5%), *Hylocomium splendens* (4%), *Brachythecium salebrosum* (2%), and *Drepanocladus aduncus* (2%), and trace amounts of *Ptilium crista-castrensis*.

Class: Forest
Subclass: Evergreen Forest
Group: Temperate or subpolar needle-leaved evergreen forest
Subgroup: Natural/Semi-natural temperate or subpolar needle-leaved evergreen forest
Formation: Temporarily flooded temperate or subpolar needle-leaved evergreen forest
Alliance: *Picea glauca* Temporarily Flooded Forest Alliance
Association: *Picea glauca - Picea mariana / Ledum groenlandicum / Equisetum arvense* Forest
Unique Identifier: n/a
Classification Confidence Level: 2 (Moderate) Only one plot completed but there was a relatively good correlation to other documented types in the literature. It was likely common throughout the boreal region.

Dominant Species: *Picea glauca, Picea mariana, Equisetum arvense, Pleurozium schreberi*
Co-Dominant Species: *Alnus incana* spp *tenuifolia, Ledum groenlandicum, Aulacomnium palustre, Hylocomium splendens, Sphagnum magellanicum*
Diagnostic Species: *Picea glauca, Picea mariana, Alnus incana* spp *tenuifolia, Equisetum arvense, Petasites frigidus var sagittatus, Petasites frigidus var palmatus, Rubus arcticus, Pleurozium schreberi, Aulacomnium palustre, Sphagnum magellanicum*

Literature Review:

Allen (2004) lists a *Picea glauca / Alnus tenuifolia - Betula neoalaskana / Equisetum pratense / Hylocomium splendens* boreal forest type (CEAB000040). It was found in riparian zones of major river valleys in northwestern Canada. This community was mostly restricted to silt-bearing rivers with extensive silt terraces where flooding was common. Soils were imperfectly drained silty alluvium Cumulic Regosols with hygric moisture levels. It tends to be old-growth forests with high biodiversity. Canopy openings were dominated by *Alnus tenuifolia, Betula neoalaskana, Cornus stolonifera* and other shrubs. The moss layer was dense. *Equisetum* spp. cover was not noted as being high.

Allen and Johnson (no date.) described a *Picea glauca / Equisetum arvense* community type from the Richardson River Dunes Wildland Park. This was a mature forest along the Athabasca River with an understorey dominated by *Rosa acicularis, Cornus stolonifera* and *Viburnum edule*.

Table 15. Summary of plot data and descriptive statistics for the *Picea glauca - Picea mariana / Ledum groenlandicum / Equisetum arvense* community type (n=1).

Strata	Code	Species	Plot
			P37
H	EQUIARV	*Equisetum arvense*	60.0
T2	PICEMAR	*Picea mariana*	25.0
T1	PICEGLA	*Picea glauca*	20.0
M	PLEUSCH	*Pleurozium schreberi*	20.0
M	SPHAMAG	*Sphagnum magellanicum*	5.0
M	AULAPAL	*Aulacomnium palustre*	5.0
S1	ALNUTEN	*Alnus incana* spp *tenuifolia*	5.0
M	HYLOSPL	*Hylocomium splendens*	4.0
S3	LEDUGRO	*Ledum groenlandicum*	3.0
M	BRACSAL	*Brachythecium salebrosum*	2.0
H	PETASAG	*Petasites frigidus var sagittatus*	2.0
M	DREPADU	*Drepanocladus aduncus*	2.0
G	CAREDIS	*Carex disperma*	1.0
H	SMILTRI	*Smilacina trifolia*	1.0
H	VIOLREN	*Viola renifolia*	1.0
S3	VACCMYR	*Vaccinium myrtilloides*	1.0
G	CALACAN	*Calamagrostis canadensis*	1.0
S3	ABIEBAL	*Abies balsamea*	0.1
H	SCUTGAL	*Scutellaria galericulata*	0.1
S3	RUBUPUB	*Rubus pubescens*	0.1
T2	POPUTRE	*Populus tremuloides*	0.1
H	PETAPAL	*Petasites frigidus var palmatus*	0.1
H	MITENUD	*Mitella nuda*	0.1
M	PTILCRI	*Ptilium crista-castrensis*	0.1
T2	POPUBAL	*Populus balsamifera*	0.1
S3	LINNBOR	*Linnaea borealis*	0.1
S3	VACCVIT	*Vaccinium vitis-idaea*	0.1
S3	LONIINV	*Lonicera involucrata*	0.1
S3	RIBETRI	*Ribes triste*	0.1
S3	PICEGLA	*Picea glauca*	0.1
H	RUBUACA	*Rubus arcticus*	0.1
H	MELALIN	*Medicago lupulina*	0.1
S3	POPUBAL	*Populus balsamifera*	0.1
H	TRIEBOR	*Trientalis borealis*	0.1
H	GEOCLIV	*Geocaulon lividum*	0.1

Beckingham and Archibald (1996) described a *Picea glauca - Picea mariana – Ledum groenlandicum / Equisetum* spp. type (h1.1) that occurred in the boreal mixedwood. This community was similar to the current type but additional species included *Salix* spp., *Rosa acicularis, Betula papyrifera, Equisetum pratense*, and *Equisetum scirpoides*. It also had more *Ledum groenlandicum* cover.

NatureServe (2004) lists a *Picea mariana / Salix myrtillifolia / Aulacomnium palustre* Woodland (CEGL002730) with a G4 ranking. This community will be part of the *Picea mariana / Sphagnum* spp. Forest Alliance (A.4053). It was a wet woodland community found in northern British Columbia's Boreal White and Black Spruce biogeoclimatic zone (Allen *et al.* 2004, Baldwin *et al.* 2004). It occurred as small patches on toe slopes or depressions. Soils were usually organic or fine-textured with organic or fluvial origins. Moisture levels were hygric to subhydric and soils were mesotrophic to permesotrophic. Stands heights were low and often *Picea mariana* forms an open canopy in the tall shrub layer. Low shrubs include high percent cover of *Ledum groenlandicum* and *Salix myrtillifolia*. The herb layer was sparse and consisted of *Vaccinium vitis-idaea, Equisetum scirpoides, Equisetum arvense* and sometimes *Arctostaphylos rubra (= Arctostaphylos alpina var. rubra)* and *Cornus canadensis*. The moss layer was dense and included *Aulacomnium palustre* and *Hylocomium splendens*, and commonly *Tomentypnum nitens, Pleurozium schreberi*, and *Sphagnum* species. Lichen cover was low but may include *Cladina* and *Peltigera* species.

NatureServe (2004) lists a *Picea glauca - Abies balsamea / Pleurozium schreberi* Forest (CEGL002509) ranked GNR. This type was found in northern Ontario (Sims *et al.* 1989), Manitoba (Greenall 1996), and possibly parts of the boreal forest. Stands were dominated by *Picea glauca* and *Abies balsamea*. The shrub and herb layer was sparse while the moss cover was high and was mainly *Pleurozium schreberi*. This type does not appear to have high cover of *Equisetum* spp. Similarity ratings for related plant community types are provided in Table 16.

Table 16. Correlation table of plant community types with similarity ratings for the *Picea mariana - Picea glauca / Ledum groenlandicum / Equisetum arvense* type.

Similar Types	Similarity Rating	Comments
Picea glauca / Alnus tenuifolia - Betula neoalaskana / Equisetum pratense / Hylocomium splendens CT (CEAB000040) Allen (2004)	3	Similar type but there are important differences in species composition and habitat conditions
Picea glauca / Equisetum arvense CT (Allen and Johnson no date)	2	Possibly a similar type but more details are required.
Picea glauca - Picea mariana – Ledum groenlandicum / Equisetum spp. CT (h1.1) (Beckingham and Archibald 1996)	1(2)	Similar type but some differences in plant community composition. This may be attributed to the small stand size and influence of adjacent communities at the North Buck Lake site.
Picea mariana / Salix myrtillifolia / Aulacomnium palustre Woodland (CEGL002730) (NatureServe 2004)	3(2)	This type has a similar species composition. Current type did not have any *Salix myrtillifolia* cover and Picea glauca was not a dominant species.
Picea glauca - Abies balsamea/ Pleurozium schreberi Forest (CEGL002509) (NatureServe 2004)	3	Few details available but this was possibly a similar type. However, *Picea mariana* and *Equisetum* spp. are not dominant species.

3.3.1.8 *Picea mariana - Larix laricina / Ledum groenlandicum / Tomentypnum nitens* Forest

Black Spruce – Tamarack / Labrador-tea / Golden Moss Forest

This community does not appear to be common and only one plot was completed in the Holmes Crossing Sandhills Ecological Reserve (Table 17). This stand occurred on a level site in a lowland depression. The micro-topography was hummocky with frequent micro-mounding of under 0.3 m. The water table at this site was less than 15 cm from the ground surface thus maintaining a relatively constant subhygric moisture level. The Organic soils were imperfectly drained and had a mesotrophic nutrient regime. This was a dense stand with 70% cover of *Picea mariana* in the tall shrub layer. A few patches of mature *Larix laricina* formed an open canopy in the overstorey. The low shrub layer had less than 15% cover consisting primarily of *Ledum groenlandicum* and *Salix myrtillifolia*. Graminoid cover was less than 10% consisting of *Carex diandra, Carex disperma, Carex chordorrhiza,* and *Calamagrostis stricta*. Moss cover was dense and included *Tomentypnum nitens* (80%), *Hylocomium splendens* (5%), *Pleurozium schreberi* (4%), and *Aulacomnium palustre* (2%).

Class: Forest
Subclass: Evergreen Forest
Group: Temperate or subpolar needle-leaved evergreen forest
Subgroup: Natural/Semi-natural temperate or subpolar needle-leaved evergreen forest
Formation: Saturated temperate or subpolar needle-leaved evergreen forest
Alliance: *Picea mariana* Saturated Forest
Association: *Picea mariana - Larix laricina / Ledum groenlandicum / Tomentypnum nitens* Forest
Unique Identifier: n/a
Classification Confidence Level: 3 (Weak) The one stand sampled was very dense and may not have been representative of the type. This type was not well represented in the literature and the geographic range was not known.

Dominant Species: *Picea mariana, Ledum groenlandicum, Tomentypnum nitens*
Co-Dominant Species: *Larix laricina, Salix myrtillifolia, Carex* spp, *Carex disperma, Hylocomium splendens, Pleurozium schreberi, Aulacomnium palustre*
Diagnostic Species: *Picea mariana, Larix laricina, Ledum groenlandicum, Tomentypnum nitens*

Table 17. Summary of plot data and descriptive statistics for the *Picea mariana - Larix laricina / Ledum groenlandicum / Tomentypnum nitens* community type (n=1).

			Plot
Strata	**Code**	**Species**	**30**
M	TOMENIT	*Tomentypnum nitens*	80.0
S1	PICEMAR	*Picea mariana*	70.0
T1	LARILAR	*Larix laricina*	8.0
S3	LEDUGRO	*Ledum groenlandicum*	8.0
M	HYLOSPL	*Hylocomium splendens*	5.0
T2	PICEMAR	*Picea mariana*	5.0
M	PLEUSCH	*Pleurozium schreberi*	4.0
G	CAREDIA	*Carex diandra*	4.0
S3	SALIMYR	*Salix myrtillifolia*	3.0
G	CAREDIS	*Carex disperma*	2.0
M	AULAPAL	*Aulacomnium palustre*	2.0
L	PELTIGE	*Peltigera sp.*	1.0
M	SPHAFUS	*Sphagnum fuscum*	0.1
G	CARECHO	*Carex chordorrhiza*	0.1
H	SMILTRI	*Smilacina trifolia*	0.1
H	RUBUACA	*Rubus arcticus*	0.1
G	CAREINT	*Carex interior*	0.1
H	PETASAG	*Petasites frigidus var sagittatus*	0.1
S3	BETUPUM	*Betula pumila*	0.1
H	POTEPAL	*Potentilla palustris*	0.1
H	ORTHSEC	*Orthilia secunda*	0.1
M	MOSSES$$	*Moss spp.*	0.1
M	DICRPOL	*Dicranum polysetum*	0.1
M	PTILCRI	*Ptilium crista-castrensis*	0.1
L	PELTAPH	*Peltigera aphthosa*	0.1
L	CLADMIT	*Cladina mitis*	0.1
G	CALASTR	*Calamagrostis stricta*	0.1
S3	VACCMYR	*Vaccinium myrtilloides*	0.1
G	CAREVAG	*Carex vaginata*	0.1
G	CAREPAP	*Carex paupercula*	0.1
H	MENYTRI	*Menyanthes trifoliata*	0.1
G	CALACAN	*Calamagrostis canadensis*	0.1
H	FRAGVIR	*Fragaria virginiana*	0.1
T1	PINUBAN	*Pinus banksiana*	0.1
S3	VACCVIT	*Vaccinium vitis-idaea*	0.1
H	EQUIARV	*Equisetum arvense*	0.1

Literature Review:

Timoney and Robinson (1998) noted a *Larix / Menyanthes / Carex diandra / Tomentypnum* community from fens in the Ft. Assiniboine Sandhills Wildland Park. Based on dominants listed for this type this would appear to be an identical or similar type.

Allen *et al.* (2002) reported that a *Picea mariana / Salix myrtillifolia / Tomentypnum nitens* Community Type found in La Butte Creek Wildland Provincial Park located north of Lake Athabasca. This type apparently occurred as small wetlands within old river channels. Other important species included *Ledum groenlandicum*, *Sphagnum fuscum,* and *S. capillifolium.*

Beckingham and Archibald (1996) described a *Picea mariana - Larix laricina / Betula pumila / Carex* spp. / *Sphagnum* spp. community type (j1.1) that occurred in the boreal mixedwood. This type has a very similar species composition but included significant cover of *Betula pumila,* has higher cover of *Sphagnum* spp. and less cover of *Tomentypnum nitens*. Similarity ratings for related plant community types are provided in Table 18.

Table 18. Correlation table of plant community types with similarity ratings for the *Picea mariana - Larix laricina / Ledum groenlandicum / Tomentypnum nitens* type.

Similar Types	Similarity Rating	Comments
Larix / Menyanthes / Carex diandra / Tomentypnum CT (fa44) (Timoney and Robinson 1998)	2(1)	Very similar type based on the dominants used to describe it. No details regarding floristics were available for review.
Picea mariana / Salix myrtillifolia / Tomentypnum nitens CT (Allen *et al.* 2002)	2	Limited information was available for this review but this appears to be a related type.
Picea mariana - Larix laricina / Betula pumila / Carex spp. / *Sphagnum* spp. (Beckingham and Archibald 1996)	1(2)	Very similar species composition although there was considerable difference in percent of individual species. *Betula pumila* was dominant in this CT, and *Sphagnum* spp. cover was dominant over *Tomentypnum nitens*.

Plate 8. *Picea glauca - Picea mariana / Ledum groenlandicum / Equisetum arvense* Forest (P37).

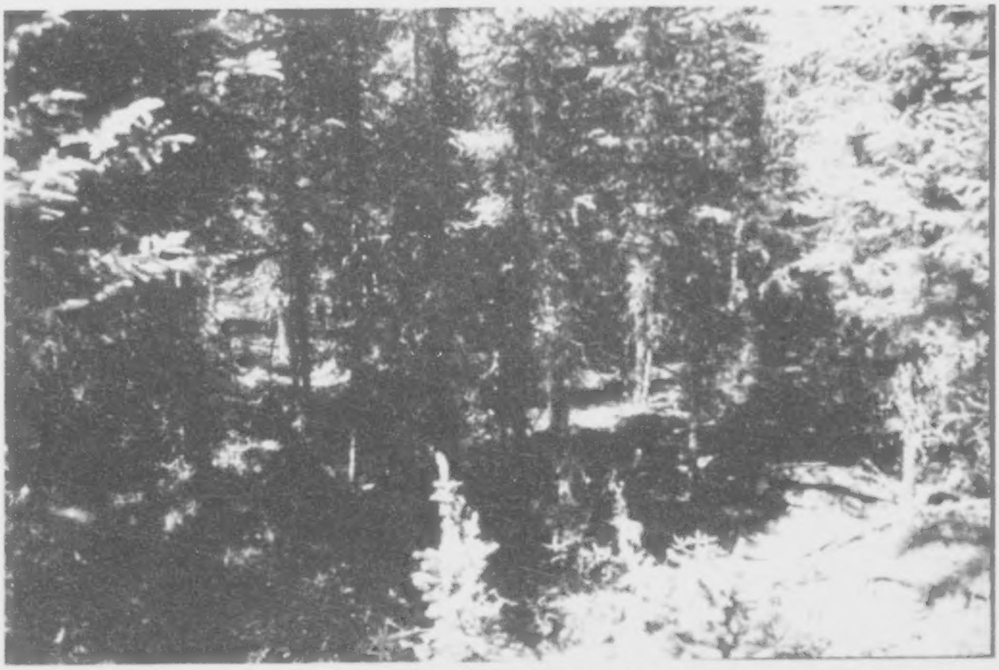


Plate 9. *Picea mariana - Larix laricina / Ledum groenlandicum / Tomentypnum nitens* Forest (P30).

3.3.1.9 *Picea mariana - Larix laricina / Pleurozium schreberi* Forest
Black Spruce - Tamarack / Schreber's Feather Moss Forest

This type was relatively common in both Boreal Sand Dunes study areas and one plot was completed in both locations (Table 19). These sites occurred on level sites in depressional areas that were likely subjected to seasonal flooding and the water table remains close to the ground surface during the entire year. Soils were moderately well to imperfectly drained Organics. Soil moisture levels were typically mesic to subhygric with submesotrophic to mesotrophic nutrient regimes. Surface substrate mean cover values were largely organic (97%) with minor amounts of decaying wood (2%) and standing water (1%). *Picea mariana* formed closed canopy stands with approximately 50% cover. *Larix laricina* was co-dominant with 3 to 10% cover and there was often some cover of *Picea glauca*, and *Betula papyrifera*. The medium and tall shrub layers had less than 10% cover consisting of *Salix maccalliana, Picea mariana, Salix bebbiana*, and other shrubs. The low shrub layer was thin with less than 5% cover composed of *Ledum groenlandicum, Ribes triste, Cornus canadensis,* and other shrubs. The herb layer was sparse yet had relatively high diversity of plant species with less than 1% cover each. These included *Equisetum arvense, Mitella nuda, Petasites frigidus var palmatus, Rubus pubescens*, and *Equisetum fluviatile*. Graminoids were present in trace amounts and included various *Carex* spp. and *Calamagrostis canadensis*. There was typically over 60% cover in the moss layer that consisted mainly of *Pleurozium schreberi* (55%), and *Hylocomium splendens* (5%). Other mosses included *Sphagnum fuscum*, *Aulacomnium palustre,* and *Ptilium crista-castrensis*. *Peltigera aphthosa* was often present.

Class: Forest
Subclass: Evergreen Forest
Group: Temperate or subpolar needle-leaved evergreen forest
Subgroup: Natural/Semi-natural temperate or subpolar needle-leaved evergreen forest
Formation: Saturated temperate or subpolar needle-leaved evergreen forest
Alliance: *Picea mariana* Saturated Forest
Association: *Picea mariana - Larix laricina / Pleurozium schreberi* Forest
Unique Identifier: n/a
Classification Confidence Level: 2 (Moderate) Only two plots were completed and there were several similar but not identical types described in the literature. Most communities include *Ledum groenlandicum* as part of the classification name for the plant association. Canopy closure in the two plots may have been higher than what was typical for this type reduced percent cover values observed in the shrub and herb/graminoid layers. This type was likely closely related to the *Picea mariana - Larix laricina / Ledum groenlandicum / Pleurozium schreberi* Forest. The current classification was likely widespread throughout the boreal region but its distribution was uncertain.

Dominant Species: *Picea mariana, Pleurozium schreberi, Usnea* spp
Co-Dominant Species: *Larix laricina, Picea glauca, Betula papyrifera, Salix maccalliana, Ledum groenlandicum, Hylocomium splendens*
Diagnostic Species: *Picea mariana, Cornus canadensis, Ledum groenlandicum, Equisetum arvense, Mitella nuda, Petasites frigidus var palmatus, Pleurozium schreberi, Hylocomium splendens, Peltigera aphthosa*

Table 19. Summary of plot data and descriptive statistics for the *Picea mariana - Larix laricina / Pleurozium schreberi* community type (n=2).

			Plots					
Strata	Code	Species	P07	P36	Mean	SE	Constancy	Prominence
M	PLEUSCH	*Pleurozium schreberi*	50.0	60.0	55.0	5.0	100.0	74.2
T1	PICEMAR	*Picea mariana*	50.0	50.0	50.0	0.0	100.0	70.7
E	USNEA$$$	*Usnea* spp.	25.0	25.0	25.0	0.0	100.0	50.0
T1	LARILAR	*Larix laricina*	10.0	3.0	6.5	3.5	100.0	25.5
E	EPIPHYT	*Epiphyte* spp.	0.0	25.0	12.5	12.5	50.0	25.0
M	HYLOSPL	*Hylocomium splendens*	10.0	1.0	5.5	4.5	100.0	23.5
S1	SALIMAC	*Salix maccalliana*	0.0	9.0	4.5	4.5	50.0	15.0
S3	LEDUGRO	*Ledum groenlandicum*	1.0	3.0	2.0	1.0	100.0	14.1
S2	PICEMAR	*Picea mariana*	2.0	1.0	1.5	0.5	100.0	12.2
T1	PICEGLA	*Picea glauca*	5.0	0.0	2.5	2.5	50.0	11.2
T2	BETUPAP	*Betula papyrifera*	5.0	0.0	2.5	2.5	50.0	11.2
S1	PICEMAR	*Picea mariana*	0.0	3.0	1.5	1.5	50.0	8.7
T1	PINUBAN	*Pinus banksiana*	3.0	0.0	1.5	1.5	50.0	8.7
T1	BETUPAP	*Betula papyrifera*	0.0	2.0	1.0	1.0	50.0	7.1
M	SPHAFUS	*Sphagnum fuscum*	0.0	2.0	1.0	1.0	50.0	7.1
S3	RIBETRI	*Ribes triste*	0.0	1.0	0.5	0.5	50.0	5.0
S1	SALIBEB	*Salix bebbiana*	1.0	0.0	0.5	0.5	50.0	5.0
H	PETAPAL	*Petasites frigidus var palmatus*	0.1	0.1	0.1	0.0	100.0	3.2
H	EQUIARV	*Equisetum arvense*	0.1	0.1	0.1	0.0	100.0	3.2
S3	CORNCAN	*Cornus canadensis*	0.1	0.1	0.1	0.0	100.0	3.2
L	PELTAPH	*Peltigera aphthosa*	0.1	0.1	0.1	0.0	100.0	3.2
H	MITENUD	*Mitella nuda*	0.1	0.1	0.1	0.0	100.0	3.2
S3	VACCMYR	*Vaccinium myrtilloides*	0.1	0.1	0.1	0.0	100.0	3.2
M	AULAPAL	*Aulacomnium palustre*	0.1	0.1	0.1	0.0	100.0	3.2
S3	GAULHIS	*Gaultheria hispidula*	0.0	0.1	0.1	0.1	50.0	1.6
M	POLYPIL	*Polytrichum piliferum*	0.0	0.1	0.1	0.1	50.0	1.6
S3	LINNBOR	*Linnaea borealis*	0.1	0.0	0.1	0.1	50.0	1.6
S3	LONIINV	*Lonicera involucrata*	0.0	0.1	0.1	0.1	50.0	1.6
S3	AMELALN	*Amelanchier alnifolia*	0.1	0.0	0.1	0.1	50.0	1.6
L	CLADONI	*Cladonia* spp.	0.1	0.0	0.1	0.1	50.0	1.6
M	PTILCRI	*Ptilium crista-castrensis*	0.1	0.0	0.1	0.1	50.0	1.6
S3	RUBUPUB	*Rubus pubescens*	0.1	0.0	0.1	0.1	50.0	1.6
H	GALIBOR	*Galium boreale*	0.1	0.0	0.1	0.1	50.0	1.6
G	CARECAN	*Carex canescens* spp *canescens*	0.0	0.1	0.1	0.1	50.0	1.6
L	ICMAERI	*Icmadophila ericetorum*	0.0	0.1	0.1	0.1	50.0	1.6
M	MOSSES$$	*Unidentified Moss* spp.	0.1	0.0	0.1	0.1	50.0	1.6
M	DICRPOL	*Dicranum polysetum*	0.0	0.1	0.1	0.1	50.0	1.6
H	VIOLREN	*Viola renifolia*	0.1	0.0	0.1	0.1	50.0	1.6
H	FRAGVIR	*Fragaria virginiana*	0.1	0.0	0.1	0.1	50.0	1.6
H	EQUIFLU	*Equisetum fluviatile*	0.0	0.1	0.1	0.1	50.0	1.6
S3	SALIMYR	*Salix myrtillifolia*	0.1	0.0	0.1	0.1	50.0	1.6
H	EQUISCI	*Equisetum scirpoides*	0.1	0.0	0.1	0.1	50.0	1.6
H	EPILANG	*Epilobium angustifolium*	0.1	0.0	0.1	0.1	50.0	1.6
H	TRIEBOR	*Trientalis borealis*	0.0	0.1	0.1	0.1	50.0	1.6
S1	ALNUVIR	*Alnus viridis*	0.1	0.0	0.1	0.1	50.0	1.6
G	CAREDIS	*Carex disperma*	0.0	0.1	0.1	0.1	50.0	1.6
G	CALACAN	*Calamagrostis canadensis*	0.1	0.0	0.1	0.1	50.0	1.6
S3	VACCVIT	*Vaccinium vitis-idaea*	0.0	0.1	0.1	0.1	50.0	1.6
H	HIERUMB	*Hieracium umbellatum*	0.1	0.0	0.1	0.1	50.0	1.6
H	ARALNUD	*Aralia nudicaulis*	0.1	0.0	0.1	0.1	50.0	1.6
H	SMILTRI	*Smilacina trifolia*	0.0	0.1	0.1	0.1	50.0	1.6
H	RUBUACA	*Rubus arcticus*	0.0	0.1	0.1	0.1	50.0	1.6
G	CARETEN	*Carex tenuiflora*	0.0	0.1	0.1	0.1	50.0	1.6
H	CALTPAL	*Caltha palustris*	0.0	0.1	0.1	0.1	50.0	1.6
H	ANEMPAR	*Anemone parviflora*	0.0	0.1	0.1	0.1	50.0	1.6
L	CLADMIT	*Cladina mitis*	0.1	0.0	0.1	0.1	50.0	1.6

Literature Review:

Raup and Argus (1982) reported a *Picea mariana / Ledum groenlandicum – Vaccinium vitis-idaea / Pleurozium schreberi* mature forest that occurred in the Athabasca Lake sand dunes area. The only vascular plants recorded for this type were *Ledum groenlandicum* and *Vaccinium vitis-idaea*, which occurred as scattered plants. Mosses formed a thick carpet and included *Pleurozium schreberi, Ptilium crista-castrensis, Orthodicranum montanum, Dicranum polysetum* and *Pohlia nutans*. Allen *et al.* (2002, 2003) reported a *Picea mariana / Pleurozium schreberi* community type was present in the Fidler-Greywillow and La Butte Creek Provincial Parks in northeastern Alberta. Trees were small in these stands and they occupied low areas in sandy undulating uplands. Another related type reported for this same area was a *Picea mariana / Ledum groenlandicum / Pleurozium schreberi* community type (Allen *et al.* 2003). Allen and Johnson (no date.) described a *Picea mariana / Pleurozium schreberi* community type from the Maybelle River Wildland Park. No details were provided regarding this type although it was located on terrace beside the Maybelle River and had some cover of *Hylocomium splendens*. Meijer (2002a) identified a *Picea mariana / Ledum groenlandicum / Pleurozium schreberi* community that occurred in this Park. There was no *Larix laricina* in this type and *Ledum groenlandicum* cover was dense (90%). Mackenzie River Basin Committee (1981) identified a *Picea mariana* / Feather Moss community at Lake Athabasca. This community was similar to the ones described above. *Ledum groenlandicum* was the dominant shrub cover, although *Alnus viridis* may also be present. Dominant mosses included *Pleurozium schreberi, Hylocomium splendens,* and *Dicranum polysetum*.

Beckingham and Archibald (1996) described a *Picea glauca – Picea mariana / Ledum groenlandicum /* Feather Moss community type (h1.2) that occurred in the boreal mixedwood. In general this type was quite similar to the current type. The main differences in these types were the lower percent cover of *Picea glauca* in the overstorey, and lack of *Populus tremuloides* and *Rosa acicularis* in the shrub layer of the Holmes Crossing and North Buck Lake type. These were considered to be minor to moderate differences. Similarity ratings for related plant community types are provided in Table 20.

Table 20. Correlation table of plant community types with similarity ratings for the *Picea mariana - Larix laricina / Pleurozium schreberi* type.

Similar Types	Similarity Rating	Comments
Picea mariana / Ledum groenlandicum – Vaccinium vitis-idaea / Pleurozium schreberi CT (Raup and Argus 1982)	2	Lake Athabasca Lake sand dune type that has limited plant diversity but was very similar to the current classification.
Picea mariana / Pleurozium schreberi CT (Allen *et al.* 2003)	2	Similar type but no details available to make a direct comparison.
Picea mariana / Pleurozium schreberi CT (Allen and Johnson no date)	3(2)	Possibly a similar type but no details regarding floristics were available for review.
Picea mariana / Ledum groenlandicum / Pleurozium schreberi CT (Meijer 2002a)	3	A similar type but percent covers of dominant species was different from the current classification.
Picea glauca -- Picea mariana / Ledum groenlandicum / Feather Moss CT (h1.2) (Beckingham and Archibald 1996)	2(1)	This CT had a similar species composition, however, there were differences in percent cover of the dominant species.

3.3.1.10 *Picea mariana - Larix laricina* Wet Forest
Black Spruce – Tamarack Wet Forest

The *Picea mariana - Larix laricina* Wet Forest stand sampled occupied a small depression that appeared to be flooding either repeatedly or for extended periods. The water table remains close to the surface over the entire year and soils were moderately well to imperfectly drained Organics. Moisture levels were typically mesic to subhygric and the soil nutrient regime was submesotrophic to mesotrophic. Surface substrates were predominantly organic (94% mean cover) and decaying wood (6%) with a trace of standing water. This stand had a very closed overstorey of *Picea mariana* (50%) and *Larix laricina* (25%) with scattered *Betula papyrifera* (Table 21). The shrub layer was dominated by *Picea mariana, Vaccinium vitis-idaea,* and *Linnaea borealis.* The herb/graminoid layer was very sparse but included trace amounts of *Orthilia secunda, Mitella nuda,* and *Carex* spp. The moss layer had less than 7% cover consisting of *Pleurozium schreberi, Hylocomium splendens, Sphagnum magellanicum,* and other species. This was a small stand that was encountered only once and it was uncertain if it was a recurring type. It appeared that a significant portion of the moss layer had recently died off perhaps due to a recent water table draw down. There were several very small openings adjacent to this plot that had substantial cover of by *Ledum groenlandicum* and *Caltha palustris* associated with small pools of standing water.

Class: Forest
Subclass: Evergreen Forest
Group: Temperate or subpolar needle-leaved evergreen forest
Subgroup: Natural/Semi-natural temperate or subpolar needle-leaved evergreen forest
Formation: Saturated temperate or subpolar needle-leaved evergreen forest
Alliance: *Picea mariana* Saturated Forest
Association: *Picea mariana - Larix laricina* Wet Forest
Unique Identifier: n/a
Classification Confidence Level: 3 (Weak) Only one stand was encountered and there was no reference to this type in the literature. Geographical distribution was unknown.

Dominant Species: *Picea mariana, Larix laricina*
Co-Dominant Species: *Betula papyrifera, Hylocomium splendens, Pleurozium schreberi*
Diagnostic Species: *Larix laricina, Picea mariana, Mitella nuda, Carex* spp, *Pleurozium schreberi, Hylocomium splendens*

Table 21. Summary of plot data and descriptive statistics for the *Picea mariana - Larix laricina* Wet Forest (n=1).

			Plot
Strata	**Code**	**Species**	**P35**
T2	PICEMAR	*Picea mariana*	50.0
T1	LARILAR	*Larix laricina*	25.0
S1	PICEMAR	*Picea mariana*	15.0
M	PLEUSCH	*Pleurozium schreberi*	4.0
E	EPIPHYT	*Epiphyte* spp.	2.0
M	HYLOSPL	*Hylocomium splendens*	1.0
T2	BETUPAP	*Betula papyrifera*	1.0
H	ORTHSEC	*Orthilia secunda*	0.1
M	MOSSES$$	*Moss* spp.	0.1
M	SPHAMAG	*Sphagnum magellanicum*	0.1
L	CLADONI	*Cladonia* spp.	0.1
G	CARELEP	*Carex leptalea*	0.1
M	POLYPIL	*Polytrichum piliferum*	0.1
G	CAREDIS	*Carex disperma*	0.1
H	MITENUD	*Mitella nuda*	0.1
S3	VACCVIT	*Vaccinium vitis-idaea*	0.1
H	CALTPAL	*Caltha palustris*	0.1
S3	LINNBOR	*Linnaea borealis*	0.1

Literature Review:
No similar types were reviewed for this type.

Plate 10. *Picea mariana - Larix laricina / Pleurozium schreberi* Forest (P7).

Plate 11. *Picea mariana - Larix laricina* Wet Forest (P35).

3.3.1.11 *Larix laricina / Betula pumila / Equisetum fluviatile* Forest
Tamarack / Dwarf Birch / Swamp Horsetail Forest

One plot was completed for this type in the Holmes Crossing Sandhills Ecological Reserve (Table 22). It was not encountered elsewhere and it was not known how common it was in either study area. The stand sampled occurred in a lowland depression that may be seasonally flooded. This was a level site and soils were poorly drained Organics with hydric moisture levels and a submesotrophic nutrient regime. Surface substrates were predominately organic matter with minor amounts of decaying wood and some standing water (<5%). *Larix laricina* forms and open canopy in the overstorey and was an important component of all other shrub layers. *Betula pumila* cover was very high at 70% followed by *Ledum groenlandicum* (10%). A variety of other shrubs were present including *Vaccinium vitis-idaea, Andromeda polifolia,* and *Oxycoccus microcarpus.* Dominant herb cover included *Equisetum fluviatile* (50%), *Menyanthes trifoliata* (40%), and *Potentilla palustris* (8%). Other species in the herb/graminoid layer included *Tofieldia glutinosa, Rubus arcticus, Carex diandra, Galium labradoricum, Carex* spp., and others. *Tomentypnum nitens* was cover was 80% and a variety of other mosses including *Aulacomnium palustre* occurred in this type. Note that no colour plate was available for plot 15.

Class: Forest
Subclass: Deciduous forest
Group: Cold-deciduous forest
Subgroup: Natural/Semi-natural
Formation: Intermittently Flooded Temperate or Subpolar Cold-deciduous Woodland
Alliance: *Larix laricina* Saturated Forest Alliance
Association: *Larix laricina / Betula pumila / Equisetum fluviatile* Forest
Unique Identifier: n/a
Classification Confidence Level: 2 (Moderate) Only one plot completed but there was a relatively good correlation to other documented types in the literature. It was likely common throughout the boreal region.

Dominant Species: *Larix laricina, Betula pumila, Equisetum fluviatile, Menyanthes trifoliata, Tomentypnum nitens, Usnea* spp.
Co-Dominant Species: *Ledum groenlandicum, Vaccinium vitis-idaea, Andromeda polifolia, Galium labradoricum, Potentilla palustris, Carex* spp, *Aulacomnium palustre*
Diagnostic Species: *Larix laricina, Betula pumila, Ledum groenlandicum, Oxycoccus microcarpus, Andromeda polifolia, Equisetum fluviatile, Menyanthes trifoliata, Potentilla palustris, Tofieldia glutinosa, Rubus arcticus, Carex diandra, Tomentypnum nitens, Aulacomnium palustre*

Literature Review:

Beckingham and Archibald (1996) identified a *Larix laricina / Betula pumila / Carex / Tomentypnum nitens* community (k.1.1) that occurred in the boreal mixedwood. All species listed for this type were recorded for the present classification with the exception of *Picea mariana, Smilacina trifolia, Caltha palustris, Calamagrostis canadensis,* and *Pleurozium schreberi.* The Holmes Crossing plot also had more *Menyanthes trifoliata* and substantial cover of *Equisetum fluviatile.* The entire species list was not provided for this k.1.1 community and these were not considered to be major differences.

NatureServe (2004) lists a *Larix laricina / Carex aquatilis* Herbaceous Vegetation (CEGL002533) that was ranked GNR. It was found north of the boreal zone in Manitoba (Greenall 1996) but few details were available for this review and this was considered a weak concept at this point requiring range-wide review. *Larix laricina* cover was 10-25% often only 4 to 5 m tall ranging to 10 m tall. Similarity ratings for related plant community types are provided in Table 23.

Table 22. Summary of plot data and descriptive statistics for the *Larix laricina / Betula pumila / Equisetum fluviatile* community type (n=1).

			Plot
Strata	**Code**	**Species**	**P15**
M	TOMENIT	*Tomentypnum nitens*	80.0
S2	BETUPUM	*Betula pumila*	70.0
E	USNEA$$$	*Usnea* spp.	60.0
H	EQUIFLU	*Equisetum fluviatile*	50.0
H	MENYTRI	*Menyanthes trifoliata*	40.0
T1	LARILAR	*Larix laricina*	20.0
S2	LARILAR	*Larix laricina*	15.0
S1	LARILAR	*Larix laricina*	10.0
S3	LEDUGRO	*Ledum groenlandicum*	10.0
H	POTEPAL	*Potentilla palustris*	8.0
S3	VACCVIT	*Vaccinium vitis-idaea*	8.0
G	CAREDIA	*Carex diandra*	7.0
M	AULAPAL	*Aulacomnium palustre*	6.0
S3	LARILAR	*Larix laricina*	5.0
S3	ANDRPOL	*Andromeda polifolia*	5.0
H	GALILAB	*Galium labradoricum*	4.0
M	DREPADU	*Drepanocladus aduncus*	4.0
H	FRAGVIR	*Fragaria virginiana*	4.0
S3	VACCMYR	*Vaccinium myrtilloides*	3.0
S3	SALIPED	*Salix pedicellaris*	3.0
M	SPHAFUS	*Sphagnum fuscum*	3.0
G	CAREINT	*Carex interior*	2.0
G	CARECHO	*Carex chordorrhiza*	1.0
S2	SALICAN	*Salix candida*	1.0
L	CLADONI	*Cladonia* spp.	1.0
G	TRIGMAR	*Triglochin maritima*	0.1
S3	OXYCMIC	*Oxycoccus microcarpus*	0.1
G	CAREDIS	*Carex disperma*	0.1
H	TOFIGLU	*Tofieldia glutinosa*	0.1
H	RUBUACA	*Rubus arcticus*	0.1
H	HABEHYP	*Platanthera hyperborea*	0.1
H	CORATRI	*Corallorhiza trifida*	0.1
M	MOSS$$$	*Unidentified Moss*	0.1

Table 23. Correlation table of plant community types with similarity ratings for the *Larix laricina / Betula pumila / Equisetum fluviatile* type.

Similar Types	Similarity Rating	Comments
Larix laricina / Betula pumila / Carex / Tomentypnum nitens CT (k.1.1) (Beckingham and Archibald 1996)	1(2)	Similar site conditions and appears to be the same type although there were some differences in the plant composition.
Larix laricina / Carex aquatilis Herbaceous Vegetation (CEGL002533) (NatureServe 2004)	3	Few details available for review and this type occurred north of the boreal zone.

3.3.1.12 *Populus tremuloides / Corylus cornuta / Aralia nudicaulis* Forest

Aspen / Beaked Hazelnut / Sarsaparilla Forest

This plant community was observed in the southern portion of the North Buck Lake study area only. The one plot completed was on a mid-slope position with a very gentle slope gradient (6%) (Table 24). Soils were well drained with mesic moisture conditions and permesotrophic (rich) nutrient levels. The closed overstorey canopy was dominated by *Populus tremuloides*. The shrub layer was relatively diverse mainly consisting of *Corylus cornuta* (40%), *Rosa acicularis* (7%), *Viburnum edule* (7), *Salix bebbiana* (6%), *Amelanchier alnifolia* (5%), and a variety of other shrubs. The herbaceous layer had approximately 20% cover consisting mainly of *Aralia nudicaulis, Disporum trachycarpum, Lathyrus ochroleucus, Mertensia paniculata, Thalictrum venulosum*, and *Calamagrostis canadensis.*

Class: Forest
Subclass: Deciduous forest
Group: Cold-deciduous forest
Subgroup: Natural/Semi-natural cold-deciduous forest
Formation: Montane or boreal cold-deciduous forest
Alliance: *Populus tremuloides* Forest Alliance
Association: *Populus tremuloides / Corylus cornuta / Aralia nudicaulis* Forest
Unique Identifier: n/a
Classification Confidence Level: 1 (Strong) A distinct type that was relatively well documented in the literature. This was likely a widespread type in the southern boreal region but exact range was uncertain.

Dominant Species: *Populus tremuloides, Corylus cornuta, Aralia nudicaulis*
Co-Dominant Species: *Rosa acicularis, Viburnum edule, Salix bebbiana, Lathyrus ochroleucus, Amelanchier alnifolia, Calamagrostis canadensis*
Diagnostic Species: *Populus tremuloides, Corylus cornuta, Aralia nudicaulis, Disporum trachycarpum, Lathyrus ochroleucus, Mertensia paniculata, Thalictrum venulosum*

Table 24. Summary of plot data and descriptive statistics for the *Populus tremuloides / Corylus cornuta / Aralia nudicaulis* community type (n=1).

			Plot
Strata	Code	Species	52
T1	POPUTRE	*Populus tremuloides*	50.0
S2	CORYCOR	*Corylus cornuta*	40.0
H	ARALNUD	*Aralia nudicaulis*	16.0
S2	ROSAACI	*Rosa acicularis*	7.0
S2	VIBUEDU	*Viburnum edule*	7.0
S1	SALIBEB	*Salix bebbiana*	6.0
S1	AMELALN	*Amelanchier alnifolia*	5.0
S1	POPUTRE	*Populus tremuloides*	2.0
G	CALACAN	*Calamagrostis canadensis*	1.0
H	LATHOCH	*Lathyrus ochroleucus*	1.0
H	FRAGVIR	*Fragaria virginiana*	1.0
S3	CORNCAN	*Cornus canadensis*	1.0
S3	RUBUIDA	*Rubus idaeus*	1.0
H	PYROCHL	*Pyrola chlorantha*	0.1
S3	RUBUPUB	*Rubus pubescens*	0.1
H	ORTHSEC	*Orthilia secunda*	0.1
H	ASTECON	*Aster conspicuus*	0.1
H	EPILANG	*Epilobium angustifolium*	0.1
H	ACTARUB	*Actaea rubra*	0.1
G	ORYZPUN	*Oryzopsis pungens*	0.1
H	MAIACAN	*Maianthemum canadense*	0.1
H	PYROASA	*Pyrola asarifolia*	0.1
H	GALIBOR	*Galium boreale*	0.1
H	EQUISYL	*Equisetum sylvaticum*	0.1
H	EQUIARV	*Equisetum arvense*	0.1
S3	LINNBOR	*Linnaea borealis*	0.1
S3	LONIDIO	*Lonicera dioica*	0.1
H	PETAPAL	*Petasites frigidus var palmatus*	0.1
H	MERTPAN	*Mertensia paniculata*	0.1
H	APOCAND	*Apocynum androsaemifolium*	0.1
H	VICIAME	*Vicia americana*	0.1
G	CARESIC	*Carex siccata*	0.1
H	THALVEN	*Thalictrum venulosum*	0.1
H	DISPTRA	*Disporum trachycarpum*	0.1
H	ASTECIL	*Aster ciliolatus*	0.1
S1	BETUPAP	*Betula papyrifera*	0.1
G	ELYMINN	*Leymus innovatus*	0.1

Literature:

Allen (2004) lists a *Populus tremuloides / Salix bebbiana - Corylus cornuta / Calamagrostis canadensis - Matteuccia struthiopteris* community type (CEAB000045) that was ranked S1 in Alberta. It occupies riparian wet meadow sites in the Central Mixedwood Natural Subregion that were imperfectly drained with hygric moisture regimes (Timoney and Robinson 1998). Large fluctuations in the water table resulting from stream flooding and possibly beaver activity directly influence stand composition. Typically the *Populus tremuloides* canopy was open with approximately 10% cover in the tall shrub layer and 17% in the low shrub layer. *Calamagrostis canadensis* cover was approximately 45% and *Matteuccia struthiopteris* cover was approximately 25%. This type appeared similar to the current classification. However, the North Buck Lake community was a closed canopy forest on well-drained soils with a mesic moisture regime. No flooding hazard was expected at this site. In addition, *Calamagrostis canadensis* cover was only 1% and there was no cover of *Matteuccia struthiopteris* recorded for this plot.

Downing and Karpuk (1992) described a *Populus tremuloides / Corylus cornuta / Aralia nudicaulis* Vegetation Type for the Low Boreal Mixedwood Ecoregion of East-central Alberta. This type appears to be a very similar to identical plant community type that commonly occurred on sandy clay loam soils. Virtually all species listed for this type also occurred in the current plot with the exception of *Populus balsamifera, Prunus* spp., *Rosa woodsii, Symphoricarpos albus* and a few others. These were not considered to be significant differences and most differences were likely the result of the small sample size on the current study. This type was also described by Beckingham and Archibald (1996) as a *Populus tremuloides / Corylus cornuta* plant community (d1.3) that occurred in the boreal mixedwood. This type also appears to be very similar to the community inventoried in the North Buck Lake study area. The only difference was a lack of *Populus balsamifera, Picea glauca, Prunus* spp. and *Symphoricarpos albus* in the current community type. Again the lack of these species was considered a minor difference and can likely be attributed to the small sample size.

Coenen (2003) described a *Populus balsamifera / Corylus cornuta – Cornus stolonifera / Aralia nudicaulis* community from the Wainwright Dunes Ecological Reserve. Species composition was virtually identical to the North Buck Lake community with the exception of *Populus tremuloides* as the dominant tree species and the lack of *Cornus stolonifera* cover in the plot completed on the current study. *Populus tremuloides* X *P. balsamifera* hybrids were noted in several areas within the boreal sand dunes and it was possible that these were present at the one plot sampled. Also *Cornus stolonifera* was relatively common in the boreal sand dunes and additional sampling may indicate that this species was a component of this community as well. The key differences in floristics were most likely attributable to the wetter moisture regime of the Wainwright plots in comparison to the North Buck Lake plot. Cottonwood Consultants Ltd (1986) also identified a similar aspen forest that occurred in moister depressions. Important shrub included choke cherry, saskatoon, beaked hazelnut, red osier dogwood, wild red raspberry, and snowberry. Herbs included northern bedstraw, pink wintergreen, dewberry, veiny meadowrue, and western Canada violet.

NatureServe (2004) lists a *Populus tremuloides / Corylus cornuta* Forest (CEGL000583) found in Colorado, Wyoming, the Dakotas, and southern Saskatchewan. It occurred on a variety of aspects, usually northerly facing and well-developed, deep soils. *Populus tremuloides* forms a closed canopy and *Betula papyrifera* may be codominant. *Quercus macrocarpa, Fraxinus pennsylvanica, Picea glauca,* and *Pinus ponderosa* may also be present. The shrub and forb layers were well developed. Important shrubs include *Corylus cornuta, Amelanchier alnifolia, Mahonia repens, Prunus virginiana, Symphoricarpos* spp., and *Rubus idaeus*. In the herb layer important species include *Aralia nudicaulis, Lathyrus ochroleucus, Maianthemum canadense, Galium triflorum, Maianthemum stellatum, Viola* spp., and *Sanicula marilandica*. Graminoid cover was light but *Carex pensylvanica* may be common in eastern stands. Similarity ratings for related plant community types are provided in Table 25.

Table 25. Correlation table of plant community types with similarity ratings for the *Populus tremuloides / Corylus cornuta / Aralia nudicaulis* type.

Similar Types	Similarity Rating	Comments
Populus tremuloides / Salix bebbiana - Corylus cornuta / Calamagrostis canadensis -Matteuccia struthiopteris CT (CEAB000045) (Allen 2004)	3	This type would share the same alliance but based on floristics and ecological niche was determined to be different communities.
Populus tremuloides / Corylus cornuta / Aralia nudicaulis CT (Downing and Karpuk 1992)	1	Appears to be an identical plant community that occurred on similar sites.
Populus tremuloides / Corylus cornuta CT (d1.3) (Beckingham and Archibald 1996)	1	Very similar site conditions and plant community composition.
Populus balsamifera / Corylus cornuta – Cornus stolonifera / Aralia nudicaulis CT (Coenen 2003)	2	Virtually identical community type but it occurred on wetter sites.
Aspen Woodland (Cottonwood Consultants Ltd. 1986)	3	A broad description of this type was provided but no percent covers. However, it seems to be a similar type.
Populus tremuloides / Corylus cornuta Forest (CEGL000583) (NatureServe 2004)	2	Appears to have very similar floristics however it features a number of species not found in the boreal sand dunes.

3.3.1.13 *Populus tremuloides / Vaccinium myrtilloides / Arctostaphylos uva-ursi* Forest
Aspen / Common Blueberry / Bearberry Forest

This community type was more common in the North Buck Lake study area where it was frequently encountered. Two samples were completed at North Buck Lake (Table 26). Sites were located on broad dune crests to upper slope positions that were nearly level to gentle slopes ranging between 4% and 16% slope gradients. Soils were typically loamy fine sands that were well drained with mesic soil moisture levels and a mesotrophic nutrient regime. Surface substrate groundcover was predominately organic matter, with less than 1% mineral soil and under 5% decaying wood. The overstorey had 10% to 40% cover of *Populus tremuloides* and sometimes included scattered *Betula papyrifera* and *Picea glauca*. The mid and upper shrub layers had low percent cover values. The low shrub layer had about 75% cover that consisted mainly of *Vaccinium myrtilloides* (42%), *Vaccinium vitis-idaea* (14%), *Arctostaphylos uva-ursi* (8%), *Rosa acicularis,* and *Ledum groenlandicum*. The herb and graminoid layers were diverse and included *Lathyrus ochroleucus, Maianthemum canadense, Trientalis borealis, Oryzopsis pungens,* and *Leymus innovatus*.

Class: Forest
Subclass: Deciduous forest
Group: Cold-deciduous forest
Subgroup: Natural/Semi-natural cold-deciduous forest
Formation: Montane or boreal cold-deciduous forest
Alliance: *Populus tremuloides* Forest Alliance
Association: *Populus tremuloides / Vaccinium myrtilloides / Arctostaphylos uva-ursi* Forest
Unique Identifier: n/a
Classification Confidence Level: 2 (Moderate) This was a recognisable type in the North Buck Lake study area but there was considerable variability between stands and it was not well documented in the literature. This type may have a relatively restricted range.

Dominant Species: *Populus tremuloides, Arctostaphylos uva-ursi, Vaccinium myrtilloides, Vaccinium vitis-idaea, Maianthemum canadense, Leymus innovatus*
Co-Dominant Species: *Betula papyrifera, Ledum groenlandicum, Rosa acicularis, Cornus canadensis, Calamagrostis canadensis, Carex siccata, Oryzopsis pungens, Cladina mitis*
Diagnostic Species: *Populus tremuloides, Betula papyrifera, Rosa acicularis, Vaccinium myrtilloides, Arctostaphylos uva-ursi, Cornus canadensis, Lathyrus ochroleucus, Maianthemum canadense, Trientalis borealis, Oryzopsis pungens*

Literature Review:

Beckingham and Archibald (1996) identified a *Pinus banksiana - Populus tremuloides / Vaccinium myrtilloides – Arctostaphylos uva-ursi* plant community (b1.1) found in the boreal mixedwood. This type was similar to the current classification. The only diagnostic species listed for this type that was not recorded on the North Buck Lake plots was *Picea mariana*. Stands sampled on the current study were more open and had less *Pinus banksiana* and *Shepherdia canadensis* cover.

Downing and Karpuk (1992) described a *Populus tremuloides / Rosa* spp. – *Vaccinium* spp. vegetation type that was scattered throughout the Low Boreal Mixedwood Ecoregion. It occurred on dry, rapidly to well-drained sites that had sandy to stony textured soils. The plant species composition of this community was very similar to the current classification. However, this plant community has a more closed canopy layer and there were some differences in percent cover values of the dominant species. *Petasites palmatus* was listed as a co-dominant species for this type but was not recorded during the current study.

Coenen (2003) identified a *Populus tremuloides / Prunus virginiana – Amelanchier / Carex siccata* community type in the Wainwright Dunes Ecological Reserve. Plant species in common between this type and the current classification included *Populus tremuloides, Amelanchier alnifolia, Rosa acicularis, Arctostaphylos uva-ursi, Maianthemum canadense, Lathyrus ochroleucus*, and several others. However, this community did not include *Betula papyrifera, Vaccinium myrtilloides, Vaccinium vitis-idaea, Cornus canadensis, Trientalis borealis, Oryzopsis pungens, Leymus innovatus*, and other important species found in the North Buck Lake plots.

NatureServe (2004) lists a *Populus (tremuloides, balsamifera) - (Betula papyrifera) - Picea mariana / Alnus viridis* Forest (CEGL002514) that was ranked GNR. This community was found in the boreal regions of central and eastern Canada, including Manitoba (Greenall 1996), and may extend into adjacent areas of the United States. The overstorey was dominated by *Populus tremuloides* and *Populus balsamifera* in various mixtures and often included scattered *Betula papyrifera* and *Picea mariana*. The moss layer was dominated by *Pleurozium schreberi*.

NatureServe (2004) describes a *Populus tremuloides - Betula papyrifera / (Abies balsamea, Picea glauca)* Forest (CEGL002466) that was found in the boreal regions. It was reported to occur in Manitoba, Ontario, possibly Quebec, and adjacent areas in the United States. Site positions include ridgetops and gentle to moderate upper to lower slopes. Soils were well to rapidly drained with dry to mesic moisture conditions. Soil textures were typically clay loamy, silt or fine sand. The overstorey was dominated by *Betula papyrifera* and *Populus tremuloides*, with some *Populus grandidentata*. The understorey canopy included *Abies balsamea* and *Picea glauca*. Important shrubs include *Acer spicatum, Corylus cornuta, Diervilla lonicera, Linnaea borealis, Lonicera canadensis, Rosa acicularis, Rubus pubescens, Sorbus decora*, and *Vaccinium myrtilloides*. The herb layer consisted mainly of *Aster macrophyllus*. Other typical herbs include *Anemone quinquefolia, Aralia nudicaulis, Clintonia borealis, Cornus canadensis, Galium triflorum, Maianthemum canadense, Mitella nuda, Pteridium aquilinum, Streptopus roseus, Trientalis borealis*, and *Viola renifolia*. Mosses include *Plagiomnium cuspidatum, Pleurozium schreberi, Ptilium crista-castrensis*, and *Rhytidiadelphus triquetrus*. Similarity ratings for related plant community types are provided in Table 27.

Table 26. Summary of plot data and descriptive statistics for the *Populus tremuloides / Vaccinium myrtilloides / Arctostaphylos uva-ursi* community type (n=3).

			Plots						
Strata	**Code**	**Species**	**P55**	**P60**	**P64**	**Mean**	**SE**	**Constancy**	**Prominence**
S3	VACCMYR	*Vaccinium myrtilloides*	35.0	50.0	40.0	41.7	4.4	100.0	64.5
T1	POPUTRE	*Populus tremuloides*	10.0	7.0	40.0	19.0	10.5	100.0	43.6
S3	VACCVIT	*Vaccinium vitis-idaea*	18.0	0.0	25.0	14.3	7.4	66.7	30.9
S3	ARCTUVA	*Arctostaphylos uva-ursi*	1.0	20.0	4.0	8.3	5.9	100.0	28.9
H	MAIACAN	*Maianthemum canadense*	10.0	5.0	0.1	5.0	2.9	100.0	22.4
G	ELYMINN	*Leymus innovatus*	5.0	15.0	0.0	6.7	4.4	66.7	21.1
S3	ROSAACI	*Rosa acicularis*	1.0	10.0	0.1	3.7	3.2	100.0	19.2
G	CARESIC	*Carex siccata*	0.1	10.0	0.1	3.4	3.3	100.0	18.4
G	CALACAN	*Calamagrostis canadensis*	15.0	0.0	0.1	5.0	5.0	66.7	18.3
G	ORYZPUN	*Oryzopsis pungens*	0.1	7.0	0.1	2.4	2.3	100.0	15.5
S3	LEDUGRO	*Ledum groenlandicum*	1.0	0.0	9.0	3.3	2.8	66.7	14.9
L	CLADMIT	*Cladina mitis*	0.0	0.1	8.0	2.7	2.7	66.7	13.4
S3	CORNCAN	*Cornus canadensis*	3.0	0.1	2.0	1.7	0.9	100.0	13.0
S1	BETUPAP	*Betula papyrifera*	3.0	1.0	0.0	1.3	0.9	66.7	9.4
S2	POPUTRE	*Populus tremuloides*	0.1	3.0	0.0	1.0	1.0	66.7	8.3
H	TRIEBOR	*Trientalis borealis*	3.0	0.1	0.0	1.0	1.0	66.7	8.3
H	ASTECIL	*Aster ciliolatus*	0.0	6.0	0.0	2.0	2.0	33.3	8.2
S3	LINNBOR	*Linnaea borealis*	2.0	1.0	0.0	1.0	0.6	66.7	8.2
M	PLEUSCH	*Pleurozium schreberi*	0.1	2.0	0.0	0.7	0.7	66.7	6.8
S2	BETUPAP	*Betula papyrifera*	0.0	0.0	4.0	1.3	1.3	33.3	6.7
T1	BETUPAP	*Betula papyrifera*	1.0	0.0	1.0	0.7	0.3	66.7	6.7
H	EPILANG	*Epilobium angustifolium*	0.1	1.0	0.0	0.4	0.3	66.7	4.9
E	EPIPHYT	*Epiphyte* spp.	0.1	0.0	1.0	0.4	0.3	66.7	4.9
T1	PINUBAN	*Pinus banksiana*	2.0	0.0	0.0	0.7	0.7	33.3	4.7
S1	POPUTRE	*Populus tremuloides*	0.0	2.0	0.0	0.7	0.7	33.3	4.7
H	FRAGVIR	*Fragaria virginiana*	0.0	1.0	0.0	0.3	0.3	33.3	3.3
H	EQUIPRA	*Equisetum pratense*	0.0	1.0	0.0	0.3	0.3	33.3	3.3
H	EQUISYL	*Equisetum sylvaticum*	0.0	0.0	1.0	0.3	0.3	33.3	3.3
E	USNEA$$$	*Usnea* spp.	0.0	0.0	1.0	0.3	0.3	33.3	3.3
S2	PICEGLA	*Picea glauca*	0.0	0.0	1.0	0.3	0.3	33.3	3.3
S1	PICEGLA	*Picea glauca*	1.0	0.0	0.0	0.3	0.3	33.3	3.3
S1	BETUOCC	*Betula occidentalis*	1.0	0.0	0.0	0.3	0.3	33.3	3.3
M	POLYPIL	*Polytrichum piliferum*	0.1	0.0	0.1	0.1	0.0	66.7	2.1
H	VICIAME	*Vicia americana*	0.1	0.1	0.0	0.1	0.0	66.7	2.1
H	LATHOCH	*Lathyrus ochroleucus*	0.1	0.1	0.0	0.1	0.0	66.7	2.1
S3	AMELALN	*Amelanchier alnifolia*	0.1	0.1	0.0	0.1	0.0	66.7	2.1
H	MELALIN	*Medicago lupulina*	0.1	0.1	0.0	0.1	0.0	66.7	2.1
L	CLADONI	*Cladonia* spp.	0.0	0.1	0.1	0.1	0.0	66.7	2.1
H	EQUIARV	*Equisetum arvense*	0.1	0.0	0.1	0.1	0.0	66.7	2.1
S3	PICEGLA	*Picea glauca*	0.0	0.0	0.1	0.0	0.0	33.3	1.1
S3	POPUTRE	*Populus tremuloides*	0.0	0.0	0.1	0.0	0.0	33.3	1.1
S3	PRUNPEN	*Prunus pensylvanica*	0.1	0.0	0.0	0.0	0.0	33.3	1.1
G	POAINTE	*Poa interior*	0.0	0.1	0.0	0.0	0.0	33.3	1.1
S3	PINUBAN	*Pinus banksiana*	0.0	0.0	0.1	0.0	0.0	33.3	1.1
M	MOSS$$$	*Unidentified Moss*	0.1	0.0	0.0	0.0	0.0	33.3	1.1
H	ACHIMIL	*Achillea millefolium*	0.1	0.0	0.0	0.0	0.0	33.3	1.1
M	HYLOSPL	*Hylocomium splendens*	0.1	0.0	0.0	0.0	0.0	33.3	1.1
M	PTILCRI	*Ptilium crista-castrensis*	0.0	0.1	0.0	0.0	0.0	33.3	1.1
H	GEOCLIV	*Geocaulon lividum*	0.1	0.0	0.0	0.0	0.0	33.3	1.1
H	LILIPHI	*Lilium philadelphicum*	0.0	0.1	0.0	0.0	0.0	33.3	1.1
S2	SHEPCAN	*Shepherdia canadensis*	0.1	0.0	0.0	0.0	0.0	33.3	1.1
S2	SALIBEB	*Salix bebbiana*	0.1	0.0	0.0	0.0	0.0	33.3	1.1
G	AGROSCA	*Agrostis scabra*	0.1	0.0	0.0	0.0	0.0	33.3	1.1
M	DICRPOL	*Dicranum polysetum*	0.1	0.0	0.0	0.0	0.0	33.3	1.1
M	PYLAPOL	*Pylaisiella polyantha*	0.0	0.0	0.1	0.0	0.0	33.3	1.1
S3	RUBUPUB	*Rubus pubescens*	0.1	0.0	0.0	0.0	0.0	33.3	1.1
H	GENTAMA	*Gentianella amarella*	0.0	0.1	0.0	0.0	0.0	33.3	1.1
H	ARALNUD	*Aralia nudicaulis*	0.0	0.1	0.0	0.0	0.0	33.3	1.1

Table 27. Correlation table of plant community types with similarity ratings for the *Populus tremuloides / Vaccinium myrtilloides / Arctostaphylos uva-ursi* type.

Similar Types	Similarity Rating	Comments
Pinus banksiana - Populus tremuloides / Vaccinium myrtilloides – Arctostaphylos uva-ursi CT (b1.1) Beckingham and Archibald (1996)	2(1)	Very similar type but the current type tends to be more open with less *Pinus banksiana*.
Populus tremuloides / Rosa spp. – *Vaccinium* spp. (Downing and Karpuk 1992)	1(2)	This was a very similar community type that occurred in the Low Boreal Mixedwood Ecoregion. Species composition was quite similar although stands tend to be more closed.
Populus tremuloides / Prunus virginiana – Amelanchier / Carex siccata CT (Coenen 2003)	3	Some similarities with the current type in terms of species composition but these are clearly different communities.
Populus (tremuloides, balsamifera) - (Betula papyrifera) - Picea mariana / Alnus viridis Forest (CEGL002514) (NatureServe 2004)	3	This type may be similar but has more cover of *Picea mariana* and *Alnus viridis*. Limited details were available for this review.
Populus tremuloides - Betula papyrifera / (Abies balsamea, Picea glauca) Forest (CEGL002466) (NatureServe 2004)	2	This community occupies similar site positions and has a similar plant species composition. Differences include the presence of several eastern species, lack of *Vaccinium vitis-idaea* and *Arctostaphylos uva-ursi*, and lower cover of *Vaccinium myrtilloides*.

Plate 12. *Populus tremuloides / Corylus cornuta* Forest (P52).

Plate 13. *Populus tremuloides / Vaccinium myrtilloides / Arctostaphylos uva-ursi* Forest (P64).

3.3.1.14 *Populus tremuloides / Rosa acicularis / Aralia nudicaulis Forest*

Aspen / Prickly Rose / Sarsaparilla Forest

This was a species rich mesic aspen forest that was expected to be common in the North Buck Lake study area and likely occurred at low incidence in the Holmes Crossing Sandhills Ecological Reserve. Sites may include level to lower receiving slope. At the three (3) plots completed, soils were well-drained and nutrient regimes were mesotrophic to permesotrophic. Surface substrate cover was dominated by organic matter (95%) and decaying wood (5%). *Populus tremuloides* formed pure closed canopy forests or sometimes with significant cover of *Populus balsamifera* that approached 15% (Table 28). Other trees included scattered individuals or clumps of *Betula papyrifera* and *Picea glauca*. The shrub layer was relatively well developed and was dominated by *Rosa acicularis* (20%), *Amelanchier alnifolia* (3%), *Cornus canadensis* (3%), *Rubus idaeus* (3%), and *Vaccinium myrtilloides* (5%). Other species in the shrub layer included *Cornus stolonifera, Lonicera involucrata, Viburnum edule, Salix bebbiana, Picea glauca, Symphoricarpos occidentalis,* and *Linnaea borealis*. Dominant forb cover consisted of *Epilobium angustifolium* (21%), *Aralia nudicaulis* (11%), *Equisetum pratense* (6%), and *Equisetum arvense* (5%). Other common herbs included *Aster ciliolatus, Galium boreale, Mertensia paniculata,* and *Trientalis borealis*. Graminoid cover was limited to *Leymus innovatus* (5%), *Calamagrostis canadensis* (2%), and trace amounts of *Carex siccata*, and *Schizachne purpurascens*.

Class: Forest
Subclass: Deciduous forest
Group: Cold-deciduous forest
Subgroup: Natural/Semi-natural cold-deciduous forest
Formation: Montane or boreal cold-deciduous forest
Alliance: *Populus tremuloides* Forest Alliance
Association: *Populus tremuloides / Rosa acicularis / Aralia nudicaulis* Forest
Unique Identifier: n/a
Classification Confidence Level: 2 (Moderate) There was relatively good consistency between plots and similar types have been reported in the literature. Geographical range was uncertain.

Dominant Species: *Populus tremuloides, Rosa acicularis, Cornus canadensis, Aralia nudicaulis, Epilobium angustifolium, Equisetum pratense, Equisetum arvense, Leymus innovatus*
Co-Dominant Species: *Populus balsamifera, Betula papyrifera, Cornus stolonifera, Lonicera involucrata, Rubus idaeus, Viburnum edule, Salix bebbiana, Vaccinium myrtilloides, Linnaea borealis Equisetum sylvaticum, Fragaria virginiana, Galium boreale, Lathyrus ochroleucus, Maianthemum canadense, Trientalis borealis, Calamagrostis canadensis*
Diagnostic Species: *Populus tremuloides, Rosa acicularis, Cornus canadensis, Linnaea borealis, Aralia nudicaulis, Aster ciliolatus, Epilobium angustifolium, Equisetum pratense, Equisetum arvense, Equisetum sylvaticum, Galium boreale, Mertensia paniculata, Trientalis borealis, Calamagrostis canadensis, Leymus innovatus*

Literature Review:

Allen *et al.* (2002) noted the occurrence of a *Populus tremuloides / Viburnum edule – Rosa acicularis* community type from the La Butte Creek Wildland Provincial Park located north of Lake Athabasca. This was a common type in the Park occurring on level mesic to submesic sites. It had a diverse shrub layer that may include significant cover of *Shepherdia canadensis* and some *Picea glauca*.

Environmental Management Associates (1993) described a *Populus tremuloides – (P. balsamifera) / Rosa acicularis – (Rubus idaeus)* vegetation type that was common in the Lower Boreal Cordilleran Ecoregion. It typically occurred on mesic well-drained sites with clay loam to silty clay loam soils. Plant species composition was quite similar to the current classification although there was significantly more *Populus*

Table 28. Summary of plot data and descriptive statistics for the *Populus tremuloides / Rosa acicularis / Aralia nudicaulis* community type (n=3).

Strata	Code	Species	Plots						
			P09	P34	P54	Mean	SE	Constancy	Prominence
T1	POPUTRE	Populus tremuloides	70.0	60.0	40.0	56.7	8.8	100.0	75.3
H	EPILANG	Epilobium angustifolium	3.0	60.0	0.1	21.0	19.5	100.0	45.9
S2	ROSAACI	Rosa acicularis	20.0	25.0	15.0	20.0	2.9	100.0	44.7
H	ARALNUD	Aralia nudicaulis	10.0	8.0	15.0	11.0	2.1	100.0	33.2
G	ELYMINN	Leymus innovatus	1.0	15.0	0.1	5.4	4.8	100.0	23.2
H	EQUIARV	Equisetum arvense	1.0	3.0	10.0	4.7	2.7	100.0	21.6
H	EQUIPRA	Equisetum pratense	0.0	15.0	4.0	6.3	4.5	66.7	20.5
S2	AMELALN	Amelanchier alnifolia	10.0	0.1	0.0	3.4	3.3	66.7	15.0
S3	CORNCAN	Cornus canadensis	0.0	8.0	2.0	3.3	2.4	66.7	14.9
S3	LINNBOR	Linnaea borealis	0.1	5.0	0.1	1.7	1.6	100.0	13.2
T1	POPUBAL	Populus balsamifera	0.0	0.0	15.0	5.0	5.0	33.3	12.9
H	MAIACAN	Maianthemum canadense	2.0	2.0	0.1	1.4	0.6	100.0	11.7
G	CALACAN	Calamagrostis canadensis	0.0	5.0	0.1	1.7	1.7	66.7	10.6
H	LATHOCH	Lathyrus ochroleucus	2.0	3.0	0.0	1.7	0.9	66.7	10.5
S2	RUBUIDA	Rubus idaeus	0.0	10.0	0.0	3.3	3.3	33.3	10.5
S3	VACCMYR	Vaccinium myrtilloides	0.0	9.0	0.0	3.0	3.0	33.3	10.0
S2	CORNSTO	Cornus stolonifera	0.0	0.1	4.0	1.4	1.3	66.7	9.5
H	FRAGVIR	Fragaria virginiana	0.0	3.0	0.1	1.0	1.0	66.7	8.3
S3	ROSAACI	Rosa acicularis	0.0	0.0	6.0	2.0	2.0	33.3	8.2
S2	LONIINV	Lonicera involucrata	0.0	0.0	6.0	2.0	2.0	33.3	8.2
S3	CORNSTO	Cornus stolonifera	0.0	0.0	5.0	1.7	1.7	33.3	7.5
S3	VIBUEDU	Viburnum edule	0.0	0.0	5.0	1.7	1.7	33.3	7.5
S2	PRUNPEN	Prunus pensylvanica	4.0	0.0	0.0	1.3	1.3	33.3	6.7
S3	LONIINV	Lonicera involucrata	0.0	0.0	4.0	1.3	1.3	33.3	6.7
T1	BETUPAP	Betula papyrifera	0.0	0.0	4.0	1.3	1.3	33.3	6.7
H	GALIBOR	Galium boreale	0.1	1.0	0.1	0.4	0.3	100.0	6.3
S2	PRUNVIR	Prunus virginiana	3.0	0.0	0.0	1.0	1.0	33.3	5.8
H	RUBUPUB	Rubus pubescens	0.1	0.0	1.0	0.4	0.3	66.7	4.9
S3	RUBUIDA	Rubus idaeus	1.0	0.0	0.1	0.4	0.3	66.7	4.9
H	EQUISYL	Equisetum sylvaticum	0.0	1.0	0.1	0.4	0.3	66.7	4.9
S3	SYMPOCC	Symphoricarpos occidentalis	1.0	0.1	0.0	0.4	0.3	66.7	4.9
H	TRIEBOR	Trientalis borealis	0.0	0.1	1.0	0.4	0.3	66.7	4.9
H	CAMPROT	Campanula rotundifolia	0.1	1.0	0.0	0.4	0.3	66.7	4.9
S2	SALIBEB	Salix bebbiana	0.0	2.0	0.0	0.7	0.7	33.3	4.7
S3	SALIBEB	Salix bebbiana	0.0	2.0	0.0	0.7	0.7	33.3	4.7
S2	VIBUEDU	Viburnum edule	0.0	0.0	1.0	0.3	0.3	33.3	3.3
G	SCHIPUR	Schizachne purpurascens	1.0	0.0	0.0	0.3	0.3	33.3	3.3
S3	POPUTRE	Populus tremuloides	0.0	1.0	0.0	0.3	0.3	33.3	3.3
H	SMILSTE	Smilacina stellata	1.0	0.0	0.0	0.3	0.3	33.3	3.3
H	ASTECON	Aster conspicuus	0.0	1.0	0.0	0.3	0.3	33.3	3.3
S1	VIBUEDU	Viburnum edule	0.0	0.0	1.0	0.3	0.3	33.3	3.3
H	VICIAME	Vicia americana	0.1	0.1	0.0	0.1	0.0	66.7	2.1
H	ASTECIL	Aster ciliolatus	0.0	0.1	0.1	0.1	0.0	66.7	2.1
S3	VACCVIT	Vaccinium vitis-idaea	0.1	0.1	0.0	0.1	0.0	66.7	2.1
G	CARESIC	Carex siccata	0.1	0.0	0.1	0.1	0.0	66.7	2.1
H	MERTPAN	Mertensia paniculata	0.0	0.1	0.1	0.1	0.0	66.7	2.1
H	VIOLREN	Viola renifolia	0.0	0.0	0.1	0.0	0.0	33.3	1.1

Table 28. (Continued)

Strata	Code	Species	Plots			Mean	SE	Constancy	Prominence
			P09	P34	P54				
H	VIOLADU	Viola adunca	0.1	0.0	0.0	0.0	0.0	33.3	1.1
M	HYLOSPL	Hylocomium splendens	0.0	0.0	0.1	0.0	0.0	33.3	1.1
H	PYROCHL	Pyrola chlorantha	0.1	0.0	0.0	0.0	0.0	33.3	1.1
M	MOSS$$$	Moss spp.	0.0	0.1	0.0	0.0	0.0	33.3	1.1
H	THALVEN	Thalictrum venulosum	0.1	0.0	0.0	0.0	0.0	33.3	1.1
M	MOSSES$$	Moss spp.	0.0	0.0	0.1	0.0	0.0	33.3	1.1
M	PLEUSCH	Pleurozium schreberi	0.0	0.0	0.1	0.0	0.0	33.3	1.1
M	PTILCRI	Ptilium crista-castrensis	0.1	0.0	0.0	0.0	0.0	33.3	1.1
H	PETAPAL	Petasites frigidus var palmatus	0.0	0.0	0.1	0.0	0.0	33.3	1.1
M	BRACSAL	Brachythecium salebrosum	0.1	0.0	0.0	0.0	0.0	33.3	1.1
G	JUNCBAL	Juncus balticus	0.1	0.0	0.0	0.0	0.0	33.3	1.1
H	MITENUD	Mitella nuda	0.0	0.0	0.1	0.0	0.0	33.3	1.1
S1	ALNUVIR	Alnus viridis	0.1	0.0	0.0	0.0	0.0	33.3	1.1
H	ACHIMIL	Achillea millefolium	0.0	0.1	0.0	0.0	0.0	33.3	1.1
S3	LONIDIO	Lonicera dioica	0.1	0.0	0.0	0.0	0.0	33.3	1.1
H	ASTELAE	Aster laevis	0.1	0.0	0.0	0.0	0.0	33.3	1.1
H	GALITRF	Galium triflorum	0.0	0.0	0.1	0.0	0.0	33.3	1.1
S1	AMELALN	Amelanchier alnifolia	0.0	0.0	0.1	0.0	0.0	33.3	1.1
S3	ARCTUVA	Arctostaphylos uva-ursi	0.0	0.1	0.0	0.0	0.0	33.3	1.1
S3	RIBETRI	Ribes triste	0.0	0.0	0.1	0.0	0.0	33.3	1.1
H	LILIPHI	Lilium philadelphicum	0.0	0.1	0.0	0.0	0.0	33.3	1.1
H	EQUILAE	Equisetum laevigatum	0.1	0.0	0.0	0.0	0.0	33.3	1.1
S2	PICEGLA	Picea glauca	0.0	0.1	0.0	0.0	0.0	33.3	1.1
H	ACTARUB	Actaea rubra	0.0	0.0	0.1	0.0	0.0	33.3	1.1
S1	SALIBEB	Salix bebbiana	0.0	0.0	0.1	0.0	0.0	33.3	1.1

tremuloides regeneration and *Calamagrostis canadensis* cover. *Aralia nudicaulis* cover was considerably less than that reported for the current classification.

Beckingham and Archibald (1996) identified a *Populus tremuloides / Rosa acicularis / Aralia nudicaulis* plant community (d1.6) in the boreal mixedwood. This community type was very similar to the current classification and all diagnostic species were recorded in the North Buck Lake plots. *Picea glauca* was not found in the overstorey of the current plots but this species was observed in the understorey and stands succeed to *Picea glauca*.

NatureServe (2004) lists a *Populus tremuloides - Betula papyrifera / (Abies balsamea, Picea glauca)* Forest (CEGL002466). This community occurred in the boreal ecoregions of Minnesota, Michigan, Ontario, and Manitoba. Characteristic sites include ridgetops and gentle to moderate upper, mid, and lower slopes. Soils were well-drained to rapidly drained mineral soils with dry to mesic moisture levels. The canopy layer was dominated by *Populus tremuloides*, *Betula papyrifera* and *Populus grandidentata* may be present. Conifer cover was usually less than 25% and consisted of *Abies balsamea* and *Picea glauca*. Common shrubs include *Acer spicatum, Corylus cornuta, Diervilla lonicera, Linnaea borealis, Lonicera canadensis, Rosa acicularis, Rubus pubescens, Sorbus decora*, and *Vaccinium myrtilloides*. The dominant species in the herb layer was *Eurybia macrophylla (= Aster macrophyllus)*. Other common forbs include *Anemone quinquefolia, Aralia nudicaulis, Clintonia borealis, Cornus canadensis, Galium triflorum, Maianthemum canadense, Mitella nuda, Pteridium aquilinum, Streptopus roseus, Trientalis borealis*, and *Viola renifolia*. Important mosses were *Plagiomnium cuspidatum, Pleurozium schreberi, Ptilium crista-castrensis*, and *Rhytidiadelphus triquetrus*.

NatureServe (2004) lists *Picea mariana - Populus tremuloides* / Mixed Herbs Forest (CEGL002516) that was ranked G4G5. This type was found in the boreal regions of the upper midwestern United States and across central Canada from Manitoba (Sims *et al.* 1989, Zoladeski *et al.* 1995) to possibly Quebec. It occurred on flat to gently sloping sites with mesic to moist soils that were coarse loam, but can be clay, silt, or sand. The overstorey has a closed canopy of *Populus tremuloides* and *Picea mariana* with scattered *Betula papyrifera, Populus balsamifera, Abies balsamea, Picea glauca*, and *Pinus banksiana*. Shrub layer cover was variable and included *Diervilla lonicera, Ledum groenlandicum, Linnaea borealis, Rosa acicularis, Rubus pubescens, Vaccinium angustifolium*, and *Vaccinium myrtilloides*. The herbaceous layer was diverse and common species include *Aralia nudicaulis, Eurybia macrophylla (= Aster macrophyllus), Cornus canadensis, Coptis trifolia, Maianthemum canadense, Petasites frigidus, Trientalis borealis*, and *Viola renifolia*. Mosses were also common. Similarity ratings for related plant community types are provided in Table 29.

Table 29. Correlation table of plant community types with similarity ratings for the *Populus tremuloides / Rosa acicularis / Aralia nudicaulis* type.

Similar Types	Similarity Rating	Comments
Populus tremuloides / Viburnum edule – Rosa acicularis CT (Allen *et al.* 2002)	(2)3	A related type that may be drier. Few details were available regarding plant community composition.
Populus tremuloides – (P. balsamifera) / Rosa acicularis – (Rubus idaeus) (Environmental Management Associates 1993)	2(1)	A very similar type reported from the Low Boreal Cordilleran Ecoregion. Differences in species composition and dominance can likely be attributed mainly to the finer textured soils in that study.
Populus tremuloides / Rosa acicularis / Aralia nudicaulis CT (d1.6) (Beckingham and Archibald 1996)	1	Very good fit of this type with the current classification in terms of ecological niche and floristics.
Populus tremuloides - Betula papyrifera / (Abies balsamea, Picea glauca) Forest (CEGL002466) (NatureServe 2004)	3	Similar type but sites may be somewhat drier and have poorer nutrient availability. This type included some eastern species.
Picea mariana - Populus tremuloides / Mixed Herbs Forest (CEGL002516) (NatureServe 2004)	3	*Picea mariana* was dominant in the overstorey in this type. The understorey has some similarities in species composition but included eastern species.

3.3.1.15 *Populus tremuloides / Alnus viridis / Aralia nudicaulis* Forest
Aspen / Green Alder / Sarsaparilla Forest

This was a common community type in the two study areas and a total of five plots were completed including four (4) in Holmes Crossing Sandhills Ecological Reserve and one (1) in the North Buck Lake study area (Table [illegible]). It occurred on mid-slope receiving positions and less frequently on level sites. Slope gradients average 8% and ranged between 3% and 12%. Aspects were variable although northerly and easterly aspects predominated. Soils were well drained with mesic moisture levels and mesotrophic to permesotrophic nutrient regimes. Surface substrate cover consisted mainly of organic matter (96%) and decaying wood (4%). This community type had the highest species diversity of all the communities sampled. It was recognised by the closed canopy of *Populus tremuloides*, typically 6% to 20% cover of *Alnus viridis* (mean of 16%), and high constancy of *Aralia nudicaulis* occurring at a mean percent cover of

11% (range 4% to 30%). Other important species included *Vaccinium myrtilloides, Prunus pensylvanica, Rosa acicularis, Vaccinium vitis-idaea, Rubus idaeus, Cornus canadensis, Epilobium angustifolium, Maianthemum canadense*, and *Linnaea borealis*. These stands will succeed to climax *Picea glauca* forest in the absence of wildfires. Remnant *Pinus banksiana* veterans may be present, as was the case with plot #18.

Class: Forest
Subclass: Deciduous forest
Group: Cold-deciduous forest
Subgroup: Natural/Semi-natural cold-deciduous forest
Formation: Montane or boreal cold-deciduous forest
Alliance: *Populus tremuloides* Forest Alliance
Association: *Populus tremuloides / Alnus viridis / Aralia nudicaulis* Forest
Unique Identifier: n/a
Classification Confidence Level: 1 (Strong) Distinctive type that was common in the study areas and was well documented in the literature. Was a wide spread community type but geographical range was uncertain.

Dominant Species: *Populus tremuloides, Alnus viridis, Cornus canadensis, Vaccinium myrtilloides, Aralia nudicaulis*
Co-Dominant Species: *Picea glauca, Prunus pensylvanica, Rosa acicularis, Vaccinium vitis-idaea, Epilobium angustifolium, Maianthemum canadense*
Diagnostic Species: *Populus tremuloides, Alnus viridis, Cornus canadensis, Linnaea borealis, Rubus idaeus, Vaccinium myrtilloides, Vaccinium vitis-idaea, Aralia nudicaulis, Epilobium angustifolium*

Literature Review:

Nelson *et al*. (1989) completed five (5) plots in a *Populus tremuloides / Alnus viridis / Aralia nudicaulis* community occurring in the Holmes Crossing proposed Natural Area. It was found on level to rolling sand plains. Soil textures were sand and loamy sand, and soils were classified as Orthic Eutric Brunisols. Sites were well to rapidly drained with a subxeric to submesic moisture regimes. Species composition was very similar between this type and the current classification.

Allen *et al*. (2002) noted the occurrence of a *Populus tremuloides / Alnus crispa* Community Type from the La Butte Creek Wildland Provincial Park located north of Lake Athabasca. *Alnus crispa* formed a dense shrub layer and few other species were recorded in the understorey.

Environmental Management Associates (1993) described a *Populus tremuloides – (P. balsamifera) / Alnus viridis / Aralia nudicaulis* that was common in the Lower Boreal Cordilleran Ecoregion. This type occurred on similar sites that had sandy clay loam soils. The plant species composition of this community was very similar to the current classification although *Calamagrostis canadensis* has greater cover values and was listed as a dominant species.

Beckingham and Archibald (1996) described a *Populus tremuloides / Alnus crispa* type (d1.4) occurring in the boreal mixedwood. This community appears to be similar to the current classification although *Populus balsamifera* was not present and there was no *Viburnum edule* in the shrub layer. In addition *Linnaea borealis, Rubus pubescens*, and *Calamagrostis canadensis* cover was lower in the current type. Other similar types described by Beckingham and Archibald (1996) include *the Populus tremuloides - Picea glauca / Alnus crispa* type (d2.3) and the *Picea glauca / Alnus crispa* (d3.2) community type. These were less similar to the current classification based on dominance of spruce in the overstorey and greater species divergence in the understorey and moss layers.

Table 30. Summary of plot data and descriptive statistics for the *Populus tremuloides / Alnus viridis / Aralia nudicaulis* community type (n=5).

Strata	Code	Species	Plots					Mean	SE	Constancy	Prominence
			P03	**P17**	**P18**	**P23**	**P50**				
T1	POPUTRE	Populus tremuloides	60.0	60.0	0.0	80.0	70.0	54.0	14.0	80.0	65.7
S1	ALNUVIR	Alnus viridis	15.0	6.0	20.0	20.0	20.0	16.2	2.7	100.0	40.2
S3	VACCMYR	Vaccinium myrtilloides	25.0	8.0	5.0	10.0	15.0	12.6	3.5	100.0	35.5
H	ARALNUD	Aralia nudicaulis	4.0	10.0	6.0	30.0	4.0	10.8	4.9	100.0	32.9
S3	CORNCAN	Cornus canadensis	30.0	11.0	4.0	0.1	2.0	9.4	5.5	100.0	30.7
T2	POPUTRE	Populus tremuloides	0.0	3.0	60.0	0.0	0.0	12.6	11.9	40.0	22.4
S3	ROSAACI	Rosa acicularis	15.0	6.0	4.0	3.0	0.0	5.6	2.5	80.0	21.2
S3	VACCVIT	Vaccinium vitis-idaea	2.0	0.1	20.0	0.1	0.1	4.5	3.9	100.0	21.1
T2	PICEGLA	Picea glauca	4.0	30.0	1.0	0.0	0.0	7.0	5.8	60.0	20.5
S1	PRUNPEN	Prunus pensylvanica	1.0	2.0	0.0	3.0	4.0	2.0	0.7	80.0	12.6
H	MAIACAN	Maianthemum canadense	0.1	1.0	4.0	3.0	0.0	1.6	0.8	80.0	11.4
S2	ROSAACI	Rosa acicularis	0.0	0.1	0.0	0.0	10.0	2.0	2.0	40.0	9.0
E	EPIPHYT	Epiphyte spp.	0.0	0.0	1.0	0.0	6.0	1.4	1.2	40.0	7.5
E	USNEA$$$	Usnea spp.	1.0	5.0	0.0	0.0	0.0	1.2	1.0	40.0	6.9
H	EPILANG	Epilobium angustifolium	2.0	0.1	0.1	0.1	0.1	0.5	0.4	100.0	6.9
S3	LINNBOR	Linnaea borealis	1.0	0.1	1.0	0.1	0.1	0.5	0.2	100.0	6.8
S3	RUBUIDA	Rubus idaeus	1.0	0.1	0.1	0.1	1.0	0.5	0.2	100.0	6.8
H	LYCOCOM	Diphasiastrum complanatum	0.0	0.0	3.0	1.0	0.0	0.8	0.6	40.0	5.7
T1	PICEGLA	Picea glauca	1.0	3.0	0.0	0.0	0.0	0.8	0.6	40.0	5.7
H	GALIBOR	Galium boreale	1.0	0.1	0.1	0.1	0.1	0.3	0.2	100.0	5.3
T2	BETUPAP	Betula papyrifera	0.0	1.0	0.0	0.0	2.0	0.6	0.4	40.0	4.9
T1	PINUBAN	Pinus banksiana	0.0	0.0	5.0	0.0	0.0	1.0	1.0	20.0	4.5
S1	SALIBEB	Salix bebbiana	0.0	0.0	0.0	0.1	2.0	0.4	0.4	40.0	4.1
S3	ARCTUVA	Arctostaphylos uva-ursi	0.0	0.0	4.0	0.0	0.0	0.8	0.8	20.0	4.0
H	VIOLREN	Viola renifolia	1.0	0.1	0.0	0.1	0.0	0.2	0.2	60.0	3.8
H	FRAGVIR	Fragaria virginiana	1.0	0.1	0.1	0.0	0.0	0.2	0.2	60.0	3.8
H	LYCODEN	Lycopodium dendroideum	3.0	0.0	0.0	0.0	0.0	0.6	0.6	20.0	3.5
S2	PICEGLA	Picea glauca	0.1	0.0	1.0	0.0	0.0	0.2	0.2	40.0	3.0
H	ASTECIL	Aster ciliolatus	1.0	0.0	0.0	0.0	0.1	0.2	0.2	40.0	3.0
H	PYROASA	Pyrola asarifolia	0.0	0.0	0.0	2.0	0.0	0.4	0.4	20.0	2.8
M	PLEUSCH	Pleurozium schreberi	2.0	0.0	0.0	0.0	0.0	0.4	0.4	20.0	2.8
T1	BETUPAP	Betula papyrifera	0.0	2.0	0.0	0.0	0.0	0.4	0.4	20.0	2.8
S3	LONIINV	Lonicera involucrata	2.0	0.0	0.0	0.0	0.0	0.4	0.4	20.0	2.8
S3	VIBUEDU	Viburnum edule	0.0	0.0	0.0	0.0	2.0	0.4	0.4	20.0	2.8
H	EQUIARV	Equisetum arvense	0.1	0.1	0.1	0.0	0.1	0.1	0.0	80.0	2.5
M	HYLOSPL	Hylocomium splendens	0.1	0.1	0.0	0.1	0.1	0.1	0.0	80.0	2.5
G	ELYMINN	Leymus innovatus	0.1	0.1	0.1	0.1	0.0	0.1	0.0	80.0	2.5
H	ACHIMIL	Achillea millefolium	1.0	0.0	0.0	0.0	0.0	0.2	0.2	20.0	2.0
S1	BETUPAP	Betula papyrifera	0.0	0.0	1.0	0.0	0.0	0.2	0.2	20.0	2.0
H	ORTHSEC	Orthilia secunda	0.1	0.1	0.0	0.1	0.0	0.1	0.0	60.0	1.9
G	CARESIC	Carex siccata	0.1	0.0	0.1	0.1	0.0	0.1	0.0	60.0	1.9
G	ORYZPUN	Oryzopsis pungens	0.0	0.0	0.1	0.1	0.0	0.0	0.0	40.0	1.3
G	CALACAN	Calamagrostis canadensis	0.0	0.0	0.0	0.1	0.1	0.0	0.0	40.0	1.3
M	PYLAPOL	Pylaisiella polyantha	0.0	0.1	0.0	0.0	0.1	0.0	0.0	40.0	1.3
M	PTILCRI	Ptilium crista-castrensis	0.1	0.1	0.0	0.0	0.0	0.0	0.0	40.0	1.3
S3	AMELALN	Amelanchier alnifolia	0.0	0.0	0.1	0.1	0.0	0.0	0.0	40.0	1.3

Table 30. (Continued)

Strata	Code	Species	Plots					Mean	SE	Constancy	Prominence
			P03	**P17**	**P18**	**P23**	**P50**				
H	RUBUPUB	Rubus pubescens	0.1	0.0	0.0	0.0	0.1	0.0	0.0	40.0	1.3
M	MOSSESSS	Moss spp.	0.0	0.0	0.0	0.1	0.1	0.0	0.0	40.0	1.3
H	CAMPROT	Campanula rotundifolia	0.1	0.0	0.1	0.0	0.0	0.0	0.0	40.0	1.3
H	PYROCHL	Pyrola chlorantha	0.0	0.1	0.0	0.1	0.0	0.0	0.0	40.0	1.3
M	DICRPOL	Dicranum polysetum	0.0	0.0	0.1	0.1	0.0	0.0	0.0	40.0	1.3
H	EQUIPRA	Equisetum pratense	0.0	0.1	0.1	0.0	0.0	0.0	0.0	40.0	1.3
H	MELALIN	Medicago lupulina	0.0	0.0	0.1	0.0	0.1	0.0	0.0	40.0	1.3
H	LATHOCH	Lathyrus ochroleucus	0.0	0.1	0.0	0.0	0.0	0.0	0.0	20.0	0.6
S2	PRUNPEN	Prunus pensylvanica	0.0	0.0	0.0	0.0	0.1	0.0	0.0	20.0	0.6
H	THALVEN	Thalictrum venulosum	0.0	0.0	0.0	0.1	0.0	0.0	0.0	20.0	0.6
G	POAPRAT	Poa pratensis	0.1	0.0	0.0	0.0	0.0	0.0	0.0	20.0	0.6
M	BRACSAL	Brachythecium salebrosum	0.0	0.0	0.0	0.0	0.1	0.0	0.0	20.0	0.6
H	EQUILAE	Equisetum laevigatum	0.0	0.0	0.0	0.1	0.0	0.0	0.0	20.0	0.6
H	ASTELAE	Aster laevis	0.0	0.1	0.0	0.0	0.0	0.0	0.0	20.0	0.6
S2	BETUPAP	Betula papyrifera	0.1	0.0	0.0	0.0	0.0	0.0	0.0	20.0	0.6
G	SCHIPUR	Schizachne purpurascens	0.1	0.0	0.0	0.0	0.0	0.0	0.0	20.0	0.6
H	EQUISYL	Equisetum sylvaticum	0.0	0.0	0.0	0.0	0.1	0.0	0.0	20.0	0.6
M	MOSS$$$	Moss spp.	0.0	0.1	0.0	0.0	0.0	0.0	0.0	20.0	0.6
S2	POPUTRE	Populus tremuloides	0.0	0.0	0.1	0.0	0.0	0.0	0.0	20.0	0.6
L	CLADMIT	Cladina mitis	0.0	0.0	0.1	0.0	0.0	0.0	0.0	20.0	0.6
S3	CORYCOR	Corylus cornuta	0.0	0.0	0.0	0.0	0.1	0.0	0.0	20.0	0.6
H	TRIEBOR	Trientalis borealis	0.0	0.0	0.0	0.0	0.1	0.0	0.0	20.0	0.6
S3	PRUNVIR	Prunus virginiana	0.0	0.1	0.0	0.0	0.0	0.0	0.0	20.0	0.6
H	EQUISCI	Equisetum scirpoides	0.0	0.1	0.0	0.0	0.0	0.0	0.0	20.0	0.6
H	GEOCLIV	Geocaulon lividum	0.0	0.1	0.0	0.0	0.0	0.0	0.0	20.0	0.6
H	LILIPHI	Lilium philadelphicum	0.1	0.0	0.0	0.0	0.0	0.0	0.0	20.0	0.6
H	ACTARUB	Actaea rubra	0.1	0.0	0.0	0.0	0.0	0.0	0.0	20.0	0.6

NatureServe (2004) lists a *Populus tremuloides - Quercus macrocarpa / Aralia nudicaulis* Forest (CEGL002065) that occurred in the northern tallgrass region of Manitoba, Saskatchewan and the United States. Although *Populus tremuloides* and *Aralia nudicaulis* were diagnostic of the type it shares few other similarities with the current classification. A significant difference was the inclusion of *Quercus macrocarpa* and *Ulmus americana* as important species for this type. Greenall (1996) lists a *Populus tremuloides / Alnus crispa* boreal forest community (MB FEC V5) but no other details were available.

The *Populus tremuloides / Alnus viridis / Aralia nudicaulis* Forest type was similar to the *Populus tremuloides / Corylus cornuta / Aralia nudicaulis* Forest with the main difference being the constancy and much higher percent cover of *Corylus cornuta*. Refer to the above section describing this type for ecological site and floristic details of this type. Similarity ratings for related plant community types are provided in Table 31.

Table 31. Correlation table of plant community types with similarity ratings for the *Populus tremuloides / Alnus viridis / Aralia nudicaulis* type.

Similar Types	Similarity Rating	Comments
Populus tremuloides / Alnus viridis / Aralia nudicaulis CT (Nelson *et al.* 1989)	1	Reported to occur in Holmes Crossing and appears to be the same community type based on similarities in ecological niche and floristics.
Populus tremuloides / Alnus crispa CT (Allen *et al.* 2002)	3(2)	A related type but few details were available for further comparison.
Populus tremuloides – (P. balsamifera) / Alnus viridis / Aralia nudicaulis CT (Environmental Management Associates 1993)	1	This was an identical type that was reported to be common in the Lower Boreal Cordilleran Ecoregion.
Populus tremuloides / Alnus crispa CT (d1.4) (Beckingham and Archibald 1996)	1(2)	A very similar type in regards to plant composition and species dominance. *Populus balsamifera* and *Viburnum edule* were co-dominants in this type but not recorded for the current classification.
Populus tremuloides - Picea glauca / Alnus crispa CT (d2.3) (Beckingham and Archibald 1996)	3	Similar species composition but *Picea glauca* was co-dominant in these stands and there was ≥ 20% cover of *Calamagrostis canadensis*.
Picea glauca / Alnus crispa CT (d3.2) (Beckingham and Archibald 1996)	3	Similar species composition but overstorey was dominated by *Picea glauca* with only minor cover of *Populus tremuloides*. Also much higher cover of feather mosses.
Populus tremuloides - Quercus macrocarpa / Aralia nudicaulis Forest (CEGL002065) (NatureServe 2004)	3	Shares some similarities to the current classification but there were major differences in species composition. Type was more typical of the northern tall grassland region where *Quercus macrocarpa* occurred.
Populus tremuloides / Alnus crispa CT (Greenall 1996)	2	Boreal forest type but no details were available for review.

Plate 14. *Populus tremuloides / Rosa acicularis / Aralia nudicaulis* Forest (P34).

Plate 15. *Populus tremuloides / Alnus viridis / Aralia nudicaulis* Forest (P50).

3.3.1.16 *Betula papyrifera / Ledum groenlandicum / Equisetum sylvaticum* Forest
Paper Birch / Labrador Tea / Woodland Horsetail

This community type occurred in locations that either experienced periodic flooding or inundation by surface runoff. The two sites sampled were both located in the North Buck Lake study area (Table 32). These included a depressional site adjacent to the west shore of North Buck Lake and a shallow drainage channel situated in a toe slope position. The slope gradient on the two sites sampled was less than 7% and site profiles were concave to straight. Soils at these sites were moderately well drained with subhygric moisture levels and permesotrophic to mesotrophic nutrient regimes. Surface substrate cover was mostly organic matter (93%) and decaying wood (7%). *Betula papyrifera* formed a closed canopy overstorey with scattered *Populus tremuloides* and *Picea mariana*. The shrub layer was variable but typically consisted of *Ledum groenlandicum, Alnus viridis, Prunus pensylvanica,* and *Vaccinium myrtilloides*. Prominent species in the herbaceous layer included *Equisetum sylvaticum, Aralia nudicaulis,* and *Calamagrostis canadensis*. Other trace species with high constancy included *Trientalis borealis, Vaccinium vitis-idaea,* and *Pleurozium schreberi*. Stands were typically small and the diversity of plant species found in these community types was likely influenced by the invasion of common species from adjacent stands.

Class: Forest
Subclass: Deciduous forest
Group: Cold-deciduous forest
Subgroup: Natural/Semi-natural cold-deciduous forest
Formation: Montane or boreal cold-deciduous forest
Alliance: *Betula papyrifera* Forest Alliance
Association: *Betula papyrifera / Ledum groenlandicum / Equisetum sylvaticum* Forest
Unique Identifier: n/a
Classification Confidence Level: 3 (Weak) A distinctive type that was dominated by *Betula papyrifera*. There were only two plots completed and both were in small stands where adjacent communities likely influenced plant composition. This type was not well documented and the geographical distribution was not known.

Dominant Species: *Betula papyrifera, Ledum groenlandicum, Equisetum sylvaticum*
Co-Dominant Species: *Populus tremuloides, Alnus viridis, Prunus pensylvanica, Vaccinium myrtilloides, Aralia nudicaulis*
Diagnostic Species: *Betula papyrifera, Populus tremuloides, Ledum groenlandicum, Vaccinium myrtilloides, Aralia nudicaulis, Equisetum sylvaticum, Calamagrostis canadensis*

Literature Review:

Timoney and Robinson (1998) noted a *Picea glauca / Betula papyrifera / Populus tremuloides / Equisetum pratense* forest type in the Ft. Assiniboine Sandhills Wildland Park. This was an old-growth forest but no other details were provided.

Beckingham and Archibald (1996) described a *Populus tremuloides – Betula papyrifera / Vaccinium myrtilloides – Ledum groenlandicum* type (b2.3) for the boreal mixedwood. This community was distantly related to the current type. However, *Populus tremuloides* was dominant in the overstorey instead of co-dominant and *Picea glauca* was co-dominant rather than absent. *Ledum groenlandicum, Vaccinium vitis-idaea, Linnaea borealis, Cornus canadensis,* and *Calamagrostis canadensis* cover was higher in this type. In the moss layer *Pleurozium schreberi* and *Hylocomium splendens* cover was slightly greater in the b2.3 type. More significantly there was an absence of *Equisetum sylvaticum* in this type.

Table 32. Summary of plot data and descriptive statistics for the *Betula papyrifera / Ledum groenlandicum / Equisetum sylvaticum* community type (n=2).

			Plots					
Strata	**Code**	**Species**	**P46**	**P51**	**Mean**	**SE**	**Constancy**	**Prominence**
T1	BETUPAP	*Betula papyrifera*	70.0	70.0	70.0	0.0	100.0	83.7
S1	BETUPAP	*Betula papyrifera*	7.0	3.0	5.0	2.0	100.0	22.4
H	EQUISYL	*Equisetum sylvaticum*	5.0	4.0	4.5	0.5	100.0	21.2
S3	LEDUGRO	*Ledum groenlandicum*	8.0	0.1	4.1	4.0	100.0	20.1
T1	POPUTRE	*Populus tremuloides*	1.0	5.0	3.0	2.0	100.0	17.3
S3	VACCMYR	*Vaccinium myrtilloides*	5.0	0.1	2.6	2.5	100.0	16.0
H	ARALNUD	*Aralia nudicaulis*	4.0	0.1	2.1	2.0	100.0	14.3
S1	POPUTRE	*Populus tremuloides*	5.0	0.0	2.5	2.5	50.0	11.2
S1	PRUNPEN	*Prunus pensylvanica*	4.0	0.0	2.0	2.0	50.0	10.0
S1	ALNUVIR	*Alnus viridis*	0.0	4.0	2.0	2.0	50.0	10.0
G	CALACAN	*Calamagrostis canadensis*	0.1	1.0	0.6	0.5	100.0	7.4
S2	PICEMAR	*Picea mariana*	0.0	2.0	1.0	1.0	50.0	7.1
T1	PICEMAR	*Picea mariana*	0.0	2.0	1.0	1.0	50.0	7.1
S3	PRUNPEN	*Prunus pensylvanica*	1.0	0.0	0.5	0.5	50.0	5.0
M	PLEUSCH	*Pleurozium schreberi*	0.1	0.1	0.1	0.0	100.0	3.2
H	TRIEBOR	*Trientalis borealis*	0.1	0.1	0.1	0.0	100.0	3.2
S3	VACCVIT	*Vaccinium vitis-idaea*	0.1	0.1	0.1	0.0	100.0	3.2
M	PTILCRI	*Ptilium crista-castrensis*	0.0	0.1	0.1	0.1	50.0	1.6
M	MOSS$$$	*Unidentified Moss*	0.0	0.1	0.1	0.1	50.0	1.6
S3	CORNCAN	*Cornus canadensis*	0.0	0.1	0.1	0.1	50.0	1.6
M	HYLOSPL	*Hylocomium splendens*	0.0	0.1	0.1	0.1	50.0	1.6
S3	ROSAACI	*Rosa acicularis*	0.0	0.1	0.1	0.1	50.0	1.6
S3	RUBUPUB	*Rubus pubescens*	0.0	0.1	0.1	0.1	50.0	1.6
G	CAREDIS	*Carex disperma*	0.0	0.1	0.1	0.1	50.0	1.6
S3	AMELALN	*Amelanchier alnifolia*	0.1	0.0	0.1	0.1	50.0	1.6
S3	LINNBOR	*Linnaea borealis*	0.0	0.1	0.1	0.1	50.0	1.6
S1	SALIBEB	*Salix bebbiana*	0.0	0.1	0.1	0.1	50.0	1.6
S3	LONIINV	*Lonicera involucrata*	0.0	0.1	0.1	0.1	50.0	1.6
S1	SALIPSE	*Salix pseudomonticola*	0.0	0.1	0.1	0.1	50.0	1.6
M	DICRPOL	*Dicranum polysetum*	0.1	0.0	0.1	0.1	50.0	1.6
H	LYCOANN	*Lycopodium annotinum*	0.0	0.1	0.1	0.1	50.0	1.6
S3	RIBETRI	*Ribes triste*	0.0	0.1	0.1	0.1	50.0	1.6

Mackenzie River Basin Committee (1981) identified a *Picea glauca / Betula neoalaskana* community at Lake Athabasca. This stand type was found along riparian and old beach habitats and may be climax stage of the current classification. It was a mature stand with Picea glauca attaining 41 cm to 60 cm diameter at breast height and supports a mesophytic undergrowth. A second type was identified as *Betula neoalaskana / Salix* spp. found on moraines, stream sides and lakeshores. *Picea mariana* was co-dominant and common species in the shrub layer included *Salix* spp. *Ledum groenlandicum, Chamaedaphne calyculata*, and *Vaccinium vitis-idaea. Pleurozium schreberi* dominated the moss layer and was associated with *Hylocomium splendens*, and *Ptilium ciliare.*

NatureServe (2004) describes a *Betula papyrifera / Diervilla lonicera - (Abies balsamea)* Forest (CEGL002463) found in the northern Great Lakes region including Ontario and possibly Manitoba. *Betula papyrifera* was the dominant canopy tree and may be associated with *Populus tremuloides, Abies balsamea, Picea glauca,* and *Pinus banksiana*. Although the overstorey was similar this type had a drier moisture regime and there was little similarity in the shrub and herbaceous layers. The dominant shrub was *Abies balsamea* and associated shrubs include *Corylus cornuta, Diervilla lonicera, Rosa acicularis*, and *Taxus canadensis*. The herbaceous layer included *Aralia nudicaulis, Eurybia macrophylla (= Aster macrophyllus), Clintonia borealis, Cornus canadensis, Maianthemum canadense*, and *Trientalis borealis*. Similarity ratings for related plant community types are provided in Table 33.

Table 33. Correlation table of plant community types with similarity ratings for the *Betula papyrifera / Ledum groenlandicum / Equisetum sylvaticum* type.

Similar Types	Similarity Rating	Comments
Picea glauca / Betula papyrifera / Populus tremuloides / Equisetum pratense CT (Timoney and Robinson 1998)	3	*Betula papyrifera* was not dominant in this type however it was likely related to the current one. More details were required regarding floristics and site characteristics to make a more exact determination.
Populus tremuloides – Betula papyrifera / Vaccinium myrtilloides – Ledum groenlandicum CT (b2.3) (Beckingham and Archibald 1996)	3	Considerable differences in species composition and dominance. No Equisetum sylvaticum was recorded for this type.
Picea glauca / Betula neoalaskana CT (Mackenzie River Basin Committee 1981)	3	*Betula neoalaskana* was dominant but it appears to occupy similar habitats and possibly the current type succeeds to this climax stage. Has a mesophytic understorey but few details are available regarding plant species composition.
Betula neoalaskana / Salix spp. CT (Mackenzie River Basin Committee 1981)	3	*Betula neoalaskana* was dominant in the tree layer. Some similarities in the shrub and moss layer but important differences in species dominance.
Betula papyrifera / Diervilla lonicera - (Abies balsamea) Forest (CEGL002463) (NatureServe 2004)	3	Similar overstorey but it occurred on drier sites resulting in differences in the species composition of the shrub and herb layers. Also differences in composition attributed to the wide geographical separation of these two types.

3.3.1.17 ***Betula papyrifera - Pinus banksiana / Alnus incana*** spp ***tenuifolia / Aralia nudicaulis*** **Forest**
Paper Birch – Jack Pine / River Alder / Sarsaparilla Forest

Mixed *Betula papyrifera - Pinus banksiana* stands were observed in a few localities within the Holmes Crossing Sandhills Ecological Reserve but did not appear to be as common in the North Buck Lake study area. Stands were small and not well defined, but generally occurred along the cool north sides of transverse sand dunes. Only one site was sampled in Holmes Crossing Sandhills Ecological Reserve (Table 34). This community was situated in an upper to mid-slope position of a north facing low sand dune with a 20% slope gradient. The soil was well drained with mesic moisture conditions and mesotrophic soil nutrient levels. Surface substrates were 97% organic matter and 3% decaying wood. Species composition was likely variable because of the invasion of plant species from adjacent community types. The overstorey at the plot completed was a mixture of *Betula papyrifera* and *Pinus banksiana*. *Picea glauca* was present in the shrub layer indicating potential succession of stands to this species in the absence of wildfire. The shrub layer was relatively open at approximately 26% cover and was dominated by *Alnus incana* spp *tenuifolia, Rosa acicularis, Vaccinium myrtilloides*, and *Vaccinium vitis-idaea*. *Aralia nudicaulis* (7% cover) was the dominant herb with only minor cover of *Geocaulon lividum, Maianthemum canadense, Rubus pubescens, Galium boreale, Viola adunca* and *Campanula rotundifolia*. Graminoids were sparse with less than 2% cover consisting of *Leymus innovatus* and *Carex siccata*. *Pleurozium schreberi* and *Hylocomium splendens* dominate the moss layer at 20% and 15% cover, respectively. Trace amounts of *Dicranum polysetum* and *Ptilium crista-castrensis* were also present. *Usnea* spp. was present at 25% cover.

Class: Forest
Subclass: Deciduous forest
Group: Cold-deciduous forest
Subgroup: Natural/Semi-natural cold-deciduous forest
Formation: Montane or boreal cold-deciduous forest
Alliance: *Betula papyrifera* Forest Alliance
Association: *Betula papyrifera - Pinus banksiana / Alnus incana* spp *tenuifolia / Aralia nudicaulis* Forest
Unique Identifier: n/a
Classification Confidence Level: 3 (Weak) Only one plot was completed in this type and it was not well correlated to other types described in the literature. Geographical distribution of this community type was unknown.

Dominant Species: *Betula papyrifera, Pinus banksiana, Alnus incana* spp *tenuifolia, Aralia nudicaulis, Pleurozium schreberi, Hylocomium splendens, Usnea* spp
Co-Dominant Species: *Rosa acicularis, Vaccinium myrtilloides, Vaccinium vitis-idaea*
Diagnostic Species: *Betula papyrifera, Pinus banksiana, Alnus incana* spp *tenuifolia, Aralia nudicaulis, Pleurozium schreberi, Hylocomium splendens*

Literature Review:

Nelson *et al.* (1989) described a *Pinus banksiana / Alnus crispa / Linnaea borealis - Vaccinium vitis-idaea* community that occurred in the Holmes Crossing Sandhills Ecological Reserve. This type also occurred on northerly aspects and has very similar species composition. The main difference was that *Pinus banksiana* formed closed canopy stands (45% mean cover) and *Betula papyrifera* cover was less than 6%. Also there was no cover of *Alnus incana* spp. *tenuifolia* recorded in the plots completed by Nelson *et al.* (1989). *Aralia nudicaulis* percent cover was similar in both types. The moss layer in both types was very similar with *Pleurozium schreberi* and *Hylocomium splendens* being dominant.

Allen *et al.* (2002) reported a *Betula papyrifera / Alnus crispa / Elymus innovatus* community type from the La Butte Creek Wildland Provincial Park located north of Lake Athabasca. This community had an open shrub layer and occurred as small stands. A second type identified in the Park was a *Betula papyrifera / Rosa acicularis* community. This type also occurred as small closed canopy stands with a sparse understorey consisting mainly of *Orthilia secunda, Pyrola asarifolia,* and leaf litter. Allen and Johnson (no date.) described a *Betula papyrifera / Vaccinium vitis-idaea* (CT 1) type from the Maybelle River Wildland Park. This uncommon type (n=1) was a mature stand occurring on the leading edge of dunes in mid-slope positions with moderately steep slope gradients (25°). Aspects were northeast and soils were rapidly drained sands that had subxeric moisture regimes. The overstorey canopy was closed but the understorey was relatively open. Most white birch stands noted in this study area and adjacent lands were *Betula papyrifera / Vaccinium myrtilloides* communities. The rare *Betula papyrifera / Vaccinium vitis-idaea / Cladina mitis* community was a more mesic type with *Picea mariana* and *Alnus crispa* (4% cover) present in the understorey.

The *Betula papyrifera / Diervilla lonicera - (Abies balsamea)* Forest (CEGL002463) occurred in the northern Great Lakes region including Ontario and possibly Manitoba (NatureServe 2004). This type has a very similar overstorey composition. *Betula papyrifera* was dominant in the overstorey but *Populus tremuloides, Abies balsamea, Picea glauca,* and *Pinus banksiana* may also be associated with this type. Typically sites were submesic to mesic which was similar to the current classification. The shrub was composed of different species including *Diervilla lonicera, Abies balsamea*, and *Corylus cornuta*. Species in common between the two types included *Rosa acicularis*, *Aralia nudicaulis*, and *Maianthemum* *canadense*. Other common herbs include *Eurybia macrophylla (= Aster macrophyllus)*, *Clintonia borealis*, *Cornus canadensis*, and *Trientalis borealis*.

NatureServe (2004) also lists an *Abies balsamea - Betula papyrifera / Diervilla lonicera* Forest (CEGL002474). This community type also occurred in Manitoba and Ontario. The canopy ranges from pure *Abies balsamea* to mixed stands with *Betula papyrifera* or sometimes *Populus tremuloides*, *Picea glauca*, and *Picea mariana*. *Pinus strobus* and *Thuja occidentalis* may also be found in these stands. Mosses also included *Hylocomium splendens*, *Pleurozium schreberi*, and *Ptilium crista-castrensis*. Species not native to Alberta included *Acer spicatum*, *Diervilla lonicera*, *Sorbus americana*, *Eurybia macrophylla (= Aster macrophyllus)*, and others. Similarity ratings for related plant community types are provided in Table 35.

Table 34. Summary of plot data and descriptive statistics for the *Betula papyrifera - Pinus banksiana / Alnus incana* spp *tenuifolia / Aralia nudicaulis* community type (n=1).

			Plot
Strata	**Code**	**Species**	**P05**
T1	BETUPAP	*Betula papyrifera*	30.0
E	USNEA$$$	*Usnea* spp	25.0
T1	PINUBAN	*Pinus banksiana*	25.0
M	PLEUSCH	*Pleurozium schreberi*	20.0
M	HYLOSPL	*Hylocomium splendens*	15.0
S1	ALNUTEN	*Alnus incana* spp *tenuifolia*	10.0
H	ARALNUD	*Aralia nudicaulis*	7.0
S3	VACCMYR	*Vaccinium myrtilloides*	6.0
S2	ROSAACI	*Rosa acicularis*	4.0
S3	VACCVIT	*Vaccinium vitis-idaea*	2.0
H	GEOCLIV	*Geocaulon lividum*	1.0
G	ELYMINN	*Leymus innovatus*	1.0
H	MAIACAN	*Maianthemum canadense*	1.0
S3	RUBUIDA	*Rubus idaeus*	1.0
S2	PRUNPEN	*Prunus pensylvanica*	1.0
S2	PICEGLA	*Picea glauca*	1.0
S3	RUBUPUB	*Rubus pubescens*	1.0
S1	PICEGLA	*Picea glauca*	1.0
G	CARESIC	*Carex siccata*	0.1
M	DICRPOL	*Dicranum polysetum*	0.1
L	CLADMIT	*Cladina mitis*	0.1
S2	AMELALN	*Amelanchier alnifolia*	0.1
M	PTILCRI	*Ptilium crista-castrensis*	0.1
S2	PRUNVIR	*Prunus virginiana*	0.1
H	GALIBOR	*Galium boreale*	0.1
S3	LINNBOR	*Linnaea borealis*	0.1
H	VIOLADU	*Viola adunca*	0.1
H	CAMPROT	*Campanula rotundifolia*	0.1

Table 35. Correlation table of plant community types with similarity ratings for the *Betula papyrifera - Pinus banksiana / Alnus incana* spp *tenuifolia / Aralia nudicaulis* type.

Similar Types	Similarity Rating	Comments
Pinus banksiana / Alnus crispa / Linnaea borealis - Vaccinium vitis-idaea CT (Nelson *et al*. 1989)	2	Very similar species composition yet quite different in terms of species that were dominant. Occurred in the Holmes Crossing Sandhills Ecological Reserve.
Betula papyrifera / Alnus crispa / Elymus innovatus CT (Allen *et al*. 2002)	3	This appears to be a related type by few details were available and additional study was required of site characteristics and floristics.
Betula papyrifera / Rosa acicularis CT (Allen *et al*. 2002)	3	This appears to be a related type by few details were available and additional study was required of site characteristics and floristics.
Betula papyrifera / Vaccinium vitis-idaea CT (Allen and Johnson no date)	2	A similar stand type that also occupies cool north facing dune slopes. *Vaccinium vitis-idaea* cover was lower in the current type but generally it was a good fit.
Betula papyrifera / Vaccinium myrtilloides CT (Allen and Johnson no date)	2	Likely a similar type but no details were available to allow a direct comparison.
Betula papyrifera / Vaccinium vitis-idaea / Cladina mitis CT (Allen and Johnson no date)	3	Possibly a related type occupying slightly different ecological niche. No details were available to allow a direct comparison.
Betula papyrifera / Diervilla lonicera - (Abies balsamea) Forest (CEGL002463) (NatureServe 2004)	3	Some similarities in overstorey and understorey species but important differences in species composition. This type possibly extends west into Manitoba
Abies balsamea - Betula papyrifera / Diervilla lonicera Forest (CEGL002474) (NatureServe 2004)	3	Similar floristics but different from current classification in the dominance of *Abies balsamea* reduced cover of *Betula papyrifera*, and presence of species in all strata that were non-native to Alberta.

Plate 16. *Betula papyrifera / Ledum groenlandicum / Equisetum sylvaticum* Forest (P46).

Plate 17. *Beula papyrifera-Pinus banksiana /Alnus incana* spp *tenuifolia /Aralia nudicaulis* Forest (P5).

3.3.2 Shrubland

3.3.2.1 *Betula pumila* - (*Salix* spp.) / *Carex diandra* / *Aulacomnium palustre* Shrubland

Dwarf Birch – (Willow) / Two-stamened Sedge / Tufted Moss Shrubland

This community type was encountered once in the Holmes Crossing Sandhills Ecological Reserve (Table 36). This was a level site in a depressional area where the water table remained permanently near the ground surface. Flooding may occur seasonally and sites were poorly drained with subhydric moisture levels. The soils were thick layers of Organic material with a mesotrophic nutrient regime. Surface substrate cover was mainly organic material (94%) with some standing water (6%) and traces of decaying wood. *Betula pumila* cover (41%) dominated the shrub layer, which also included minor percent cover of *Salix petiolaris, Salix planifolia, Salix pedicellaris, Salix bebbiana, Larix laricina*, and *Andromeda polifolia*. *Carex diandra* was the dominant graminoid at 50% cover followed by *Calamagrostis stricta* cover at 25% and *Calamagrostis canadensis* as a minor species. Total herb cover was less than 2% and included *Potentilla palustris, Equisetum fluviatile*, and *Epilobium palustre*. Moss cover was moderate and included *Aulacomnium palustre* (25%), *Drepanocladus aduncus* (8%), and *Tomentypnum nitens* (7%).

Class: Shrubland
Subclass: Deciduous Shrubland
Group: Cold-deciduous shrubland
Subgroup: Natural/Semi-natural cold-deciduous shrubland
Formation: Saturated cold-deciduous shrubland
Alliance: *Betula pumila* - (*Salix* spp.) Saturated Shrubland Alliance
Association: *Betula pumila* - (*Salix* spp.) / *Carex diandra* / *Aulacomnium palustre* Shrubland
Unique Identifier: Potentially the same type as Alberta element CEAB000126.
Classification Confidence Level: 2 (Moderate) Only one plot completed in this type and further sampling was required to better describe the type. A number of similar types are reported in the literature but the geographical range for the type was uncertain.

Dominant Species: *Betula pumila, Carex diandra, Aulacomnium palustre*
Co-Dominant Species: *Salix petiolaris, Calamagrostis stricta, Calamagrostis canadensis, Drepanocladus aduncus, Tomentypnum nitens*
Diagnostic Species: *Betula pumila, Carex diandra, Equisetum fluviatile, Potentilla palustris Aulacomnium palustre, Drepanocladus aduncus, Tomentypnum nitens*

Table 36. Summary of plot data and descriptive statistics for the *Betula pumila - (Salix* spp.) / *Carex diandra / Aulacomnium palustre* Shrubland community type (n=1).

			Plot
Strata	**Code**	**Species**	**P32**
G	CAREDIA	*Carex diandra*	50.0
S2	BETUPUM	*Betula pumila*	41.0
M	AULAPAL	*Aulacomnium palustre*	25.0
G	CALASTR	*Calamagrostis stricta*	15.0
M	DREPADU	*Drepanocladus aduncus*	8.0
M	TOMENIT	*Tomentypnum nitens*	7.0
S3	SALIPET	*Salix petiolaris*	2.0
G	CALACAN	*Calamagrostis canadensis*	2.0
S1	PINUBAN	*Pinus banksiana*	1.0
S1	LARILAR	*Larix laricina*	1.0
H	POTEPAL	*Potentilla palustris*	1.0
S3	SALIPLA	*Salix planifolia*	0.1
H	EQUIFLU	*Equisetum fluviatile*	0.1
G	POAPALU	*Poa palustris*	0.1
S3	SALIPED	*Salix pedicellaris*	0.1
S3	ANDRPOL	*Andromeda polifolia*	0.1
H	EPILPAL	*Epilobium palustre*	0.1
S3	SALIBEB	*Salix bebbiana*	0.1

Literature Review:

Nelson *et al.* (1989) completed two plots to describe a Shallow Water Community Type occurring in the Holmes Crossing area. This type appears to be very similar to the community type proposed in the current study, however, it was adjacent shallow ponds and included emergent zone vegetation such as *Nuphar variegatum* and *Potamogeton* spp. The one site sampled on the present study was located in a large depression with no open water. Timoney and Robinson (1998) noted a *Larix / Betula pumila / Drepanocladus* sp. (brown moss) community that occurred in the Ft. Assiniboine Sandhills Wildland. *Muhlenbergia glomerata* was found to be a component species within this type.

Allen and Johnson (no date.) described a *Salix* spp. – *Betula pumila* community type that occurred in the Marguerite Crag and Tail Wildland Park in northeastern Alberta. No additional details were provided other than it occurred in a wetland located between sand deposits and the Marguerite River. Meijer (2002c) identified a *Betula pumila / Carex* spp. */ Drepanocladus* sp. type that occurred in this same Park. This type had a similar species composition but percent coverage of the dominant species was substantially different. Percent cover of *Betula pumila, Carex diandra,* and *Aulacomnium palustre* were all much less and were recorded at 5%, 1% and 0% cover, respectively. *Drepanocladus* sp. was recorded at 70% cover.

Beckingham and Archibald (1996) described a *Betula pumila / Carex* spp. */ Tomentypnum nitens* type (k.2.1) in the boreal mixedwood of Alberta. This type appeared to be wetter but had very similar cover of the dominants and diagnostic species. However, in contrast to the Holmes Crossing plot dominants in this type included *Sphagnum* spp., *Smilacina trifolia, Caltha palustris,* and *Menyanthes trifoliata.* This may possibly be attributed to lower than normal water tables in the Holmes Crossing area.

Allen (2004) lists a *Betula pumila - Salix* spp. */ Carex* spp. (CEAB000126) that occurred in Parkland string fens and sand plain fens (Wallis 1990). It was a disjunct community in the Parkland and occurrences were extremely localised. This was likely a very similar type although no floristic details were available for review. According to Allen (2004) this type was not well defined and additional work was required to more accurately describe it. Currently this type has a S3? Rating in the province. Cottonwood Consultants Ltd. (1986) gives a brief account of a *Betula pumila* wetland type that occurred in interdune depressions in the Wainwright area. A variety of *Salix* spp. were recorded for this type but only *Salix planifolia* was common to the current classification. Other species in common included *Carex diandra, Calamagrostis canadensis, Equisetum fluviatile, Potentilla palustris, Drepanocladus aduncus,* and *Tomentypnum nitens.* A number of other boreal wetland species were recorded for this type notably *Carex aquatilis, C. interior, C. limosa, C. serissima, Menyanthes trifoliata, Muhlenbergia glomerata, Viola nephrophylla,* and *Sphagnum* spp.

Greenall (1996) described a *Salix planifolia - Betula pumila* var. *glandulifera* Shrubland (CEGL002529) that was listed on NatureServe (2004). This type occurred in Manitoba but no details were available regarding species composition for the community. A *Betula nana / Carex utriculata* Shrubland (CEGL001079) was described by NatureServe (2004). This community occupies marshes in the subalpine and montane riparian zones of Alberta and some areas of the western United States. The dominant shrub species was *Betula nana (= Betula glandulosa)* and other associated shrubs include *Salix planifolia, Salix geyeriana, Salix wolfii, Rhamnus alnifolia, Dasiphora fruticosa* spp. *floribunda (= Pentaphylloides floribunda), Cornus sericea, Alnus incana*, and *Ribes* spp. *Carex utriculata* dominates the herbaceous layer that also included *Calamagrostis stricta, Carex aquatilis, Carex livida*, and *Carex lasiocarpa.* Forb cover included *Cicuta maculata, Comarum palustre, Mentha arvensis, Galium* spp., *Ranunculus sceleratus, Sparganium natans (= Sparganium minimum)*, and *Thalictrum alpinum.*

NatureServe (2004) describes a *Betula pumila - Salix* spp. Prairie Fen Shrubland (CEGL002189) that occurred in the northern tallgrass prairie and adjacent prairie-forest border regions of the upper midwestern United States and extending into Manitoba. The shrub layer was dominated by *Betula pumila* and *Salix* spp were present as well. The herb/graminoid was well developed and included *Calamagrostis canadensis, Calamagrostis stricta, Carex aquatilis, Carex lasiocarpa, Eriophorum angustifolium, Lobelia kalmii, Lycopus uniflorus*, and other species. Mosses were sparse to abundant and dominated by species other than *Sphagnum* spp. Greenall (1996) listed a *Betula pumila - Salix* spp. Rich Boreal Fen Shrubland and a *Betula pumila / Carex lasiocarpa* Poor Fen Shrubland, but no details were provided for either. Similarity ratings for related plant community types are provided in Table 37.

Table 37. Correlation table of plant community types with similarity ratings for the *Betula pumila - (Salix* spp.) */ Carex diandra / Aulacomnium palustre* Shrubland type.

Similar Types	**Similarity Rating**	**Comments**
Shallow Water CT (Nelson *et al.* 1989)	1	Identical type with very similar species composition and occupying the same type of habitat.
Larix/Betula pumila/Drepanocladus sp. CT (Timoney and Robinson 1998)	3	*Betula pumila* was a dominant in this type but no further details were provided regarding floristics of this type.
Salix spp. – *Betula pumila* CT (Allen and Johnson no date)	2	Appears to be a similar type however no details regarding floristics were available for this review.
Betula pumila / Carex spp. / *Drepanocladus* sp. CT (Meijer 2002c)	2	A very similar type. The main difference seems to be in the percent cover of the dominant species.
Betula pumila / Carex spp. / *Tomentypnum nitens* CT (k.2.1) (Beckingham and Archibald 1996)	1(2)	Appears to be the same type based on similarities in diagnostic and dominant species but the plot completed on the present study was drier.
Betula pumila - Salix spp. / *Carex* spp. CT (CEAB000126) Allen (2004)	2	Appears to be the same type but insufficient details provided to increase similarity rating.
Betula pumila wetland type (Cottonwood Consultants Ltd. 1986)	2	Few details were provided but it appears to be a very similar community type.
Salix planifolia - Betula pumila var. *glandulifera* Shrubland (CEGL002529) (Greenall 1996, NatureServe 2004)	3	Dominant species occur in the *Betula pumila - (Salix* spp.) */ Carex diandra / Aulacomnium palustre* Shrubland but no other details regarding floristics were reviewed.
Betula nana / Carex utriculata Shrubland (CEGL001079) NatureServe (2004)	3	Although this type has similar structure and ecological site conditions it occurred in subalpine and montane riparian areas and there were many differences in the floristics.
Betula pumila - Salix spp. Prairie Fen Shrubland (CEGL002189) NatureServe (2004)	3	Similar structure and shares some of the same species but there were many differences in floristics and does not extend into the boreal forest region.
Betula pumila / Carex lasiocarpa Poor Fen Shrubland (Greenall 1996)	3	Possibly a similar type although the dominant *Carex* species was different.
Betula pumila - Salix spp. Rich Boreal Fen Shrubland (Greenall 1996)	2	Likely a very similar type but no details were available regarding floristics of this type.

3.3.2.2 *Salix planifolia / Calamagrostis canadensis* Shrubland

Flat-leaved Willow / Bluejoint Shrubland

This community was not common and was encountered only once in the North Buck Lake study area (Table 38). Sites were located in interdune depressional areas where the water table remains permanently near the ground surface. Flooding was likely to occur frequently and sites were very poorly drained with hydric moisture levels. Surface substrate cover was dominated by water (58%) followed by organic matter (40%) and decaying wood (2%). Soils consist of a thick layer of Organic material and nutrient levels were eutrophic. Based on percent cover values the dominant plant and key indicator species of the community were *Salix planifolia* (40%) and *Calamagrostis canadensis* (40%). Other plant and moss species occurring at low percent cover include *Salix myrtillifolia, Carex utriculata,* other *Carex* spp. and *Drepanocladus aduncus.*

Class: Shrubland
Subclass: Deciduous Shrubland
Group: Cold-deciduous shrubland
Subgroup: Natural/Semi-natural cold-deciduous shrubland
Formation: Saturated cold-deciduous shrubland
Alliance: *Salix planifolia* Saturated Shrubland Alliance
Association: *Salix planifolia - Calamagrostis canadensis* Shrubland
Unique Identifier: n/a
Classification Confidence Level: 2 (Moderate) There was a relatively good correlation of plot data with the published and unpublished literature for the type. Appears to fit within the known geographical range.

Dominant Species: *Salix planifolia, Calamagrostis canadensis*
Co-Dominant Species: *Salix myrtillifolia, Carex utriculata, Drepanocladus aduncus*
Diagnostic Species: *Salix planifolia, Calamagrostis canadensis*

Table 38. Summary of plot data and descriptive statistics for the *Salix planifolia / Calamagrostis canadensis* community type (n=1).

			Plot
Strata	**Code**	**Species**	**P59**
S1	SALIPLA	*Salix planifolia*	40.0
G	CALACAN	*Calamagrostis canadensis*	40.0
E	EPIPHYT	*Epiphyte* spp.	25.0
S2	SALIMYR	*Salix myrtillifolia*	5.0
M	DREPADU	*Drepanocladus aduncus*	3.0
G	CAREUTR	*Carex utriculata*	3.0

			Plot
Strata	**Code**	**Species**	**P59**
S2	BETUPAP	*Betula papyrifera*	0.1
G	CAREDIS	*Carex disperma*	0.1
G	CAREAQU	*Carex aquatilis*	0.1
S1	SALISER	*Salix serissima*	0.1
H	GALITRI	*Galium trifidum*	0.1

Literature Review:

Allen *et al.* (2003) reported that a *Salix planifolia - Calamagrostis canadensis* community type was present in the Fidler-Greywillow Provincial Park at Lake Athabasca. Here it formed a dense willow thicket adjacent a small creek. Raup and Argus (1982) reported a similar community that occurred near wet meadows in the Lake Athabasca area. Allen *et al.* (2002) reported a second similar type from the La Butte Creek Wildland Provincial Park located north of Lake Athabasca. This was described as a *Salix bebbiana - S. planifolia - S. petiolaris / Carex atherodes – Calamagrostis canadensis* community.

Typically it surrounded large *Carex atherodes* meadows. Allen and Johnson (no date.) described a *Salix planifolia – Salix petiolaris* community type that occurred in the Richardson River Dunes Wildland Park. No details were provided for this type except that it formed a willow ring at edge of an old beaver pond. This community type also occurred in the Birch Mountains of northern Alberta (Unpublished plot data BM:04, 17a, 26a, 32, 72; pers. comm. Keith Ainsley 2005). *Salix planifolia* and *Calamagrostis canadensis* dominated this community, however, the dominant sedge species was *Carex aquatilis* instead of C. *utriculata*. This type was tentatively described as a *Salix* spp. / *Calamagrostis canadensis* community type.

Beckingham and Archibald (196) described a *Salix* spp. / *Calamagrostis canadensis* type (k2.3) in the boreal mixedwood. In descending order of dominance, important species include *Salix* spp., *Calamagrostis canadensis, Drepanocladus* spp., *Myrica gale, Caltha palustris,* and *Menyanthes trifoliata.* The main difference with the current type was the lack of *Calamagrostis canadensis* in the k2.3 community.

Thompson and Hansen (2002) described a *Salix planifolia / Carex utriculata* Habitat Type that was very similar to the current classification. This community was a minor type in the Lower Foothills Subregion and an incidental type outside the Mixedgrass Subregions. It was associated with meadows adjacent to lakes, streams, springs and other wet sites. These stands had higher plant diversity than the current classification but common dominant species include *Salix planifolia, Calamagrostis canadensis,* and *Carex utriculata.* Sites may be seasonally flooded and had very poorly drained soils that were permanently saturated.

The current classification appears to fit into the *Salix planifolia* Saturated Shrubland Alliance (A.3514) that was a recognised type in Manitoba (Midwestern Ecology Group: NatureServe 2004). NatureServe (2004) and Greenall (1996) list a *Salix planifolia - Betula pumila* var. *glandulifera* Shrubland (CEGL002529) that may be similar to the current classification. As indicated above, this type occurred in Manitoba but no details were available regarding floristics or site conditions for the type. Another community listed by NatureServe (2004) was the *Salix planifolia - Calamagrostis canadensis* Shrubland (CEGL001225). It was common in high-elevation mountain wetlands of Wyoming, Utah, and Colorado. *Salix planifolia* cover was typically 40% to 90% and associated willows include *Salix brachycarpa* and *Salix wolfii*. *Calamagrostis canadensis* dominated the herbaceous layer along with *Carex* spp. including *Carex utriculata, Carex microptera*, and *Carex aquatilis*. Forbs may include *Caltha leptosepala, Cardamine cordifolia, Pedicularis groenlandica*, and *Mertensia ciliata*. Similarity ratings for related plant community types are provided in Table 39.

Table 39. Correlation table of plant community types with similarity ratings for the *Salix planifolia / Calamagrostis canadensis* type.

Similar Types	Similarity Rating	Comments
Salix planifolia – Calamagrostis canadensis CT (Allen *et al.* 2003, Raup and Argus 1982)	1	No details regarding site conditions and CT composition. Expected to be the same or a closely related type.
Salix bebbiana - S. planifolia - S. petiolaris / Carex atherodes – Calamagrostis canadensis CT (Allen *et al.* 2002)	3	No details regarding site conditions and CT composition but appears to be a similar type although dominant species were different.
Salix planifolia – Salix petiolaris CT (Allen and Johnson no date)	3	Possibly a similar type but no additional details were available for review.
Salix spp. *– Calamagrostis canadensis* CT (pers. comm. Keith Ainsley 2005).	1	Based on plot data this Birch Mountains CT appears to be identical.
Salix spp. */ Calamagrostis canadensis* CT (k2.3) (Beckingham and Archibald 1996)	3	Similar type but was void of *Calamagrostis canadensis* cover and there are differences in other diagnostic species.
Salix planifolia / Carex utriculata Habitat Type (Thompson and Hansen 2002)	2	Shares same ecological niche in adjacent natural subregions. Same alliance type as current classification but has different prominence of the indicator species and other dissimilarities in floristics.
Salix planifolia Saturated Shrubland Alliance (A.3514) (NatureServe 2004)	1	No details provided regarding this alliance but it was assumed that the current classification was part of this alliance type.
Salix planifolia – Betula pumila var. *glandulifera* Shrubland (CEGL002529) (Greenall 1996, NatureServe 2004)	3	Dominant plant species was the same but further assessment of similarity not possible without more details on the floristics and ecological site characteristics.
Salix planifolia – Calamagrostis canadensis Shrubland (CEGL001225) NatureServe (2004)	3	Shares same dominant species and some of the co-dominant species but otherwise floristics were dissimilar due to geographical separation.

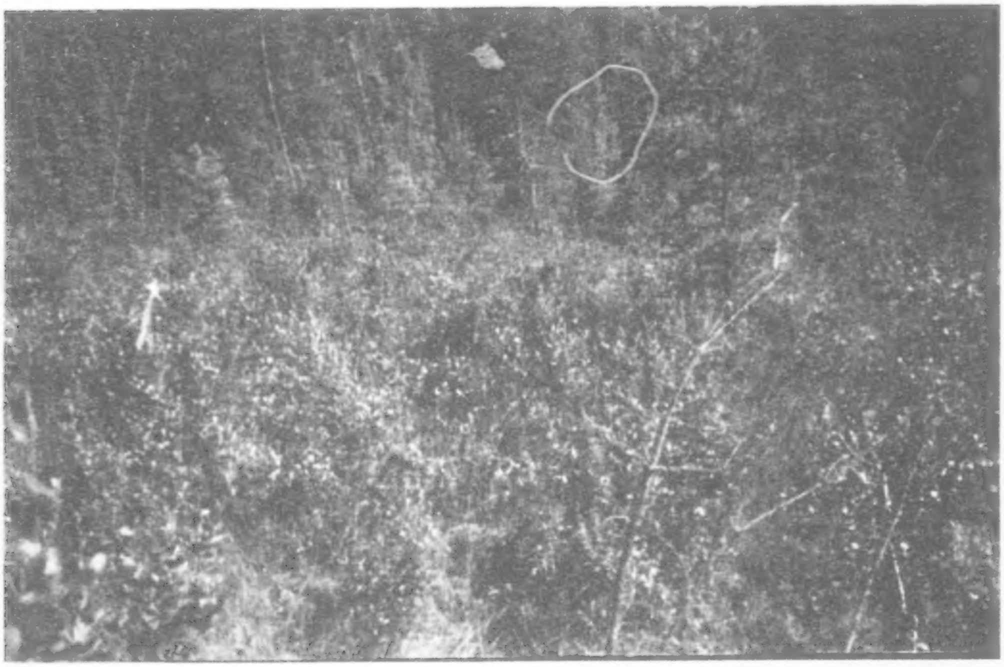


Plate 18. *Betula pumila - (Salix spp.) / Carex diandra / Aulacomnium palustre* Shrubland (P32).

Plate 19. *Salix planifolia - Calamagrostis canadensis* Shrubland (P59).

3.3.2.3 *Salix petiolaris / Carex diandra - Calamagrostis stricta Shrubland*

Basket Willow / Two-stamened Sedge – Narrow Reed Grass Shrubland

This community type occurred in interdune depressions on level sites where the water table remains permanently at the ground surface. It was not encountered in the North Buck Lake study area yet was quite common in the Holmes Crossing Sandhills Ecological Reserve where three (3) samples were completed (Table 40). Sites were frequently flooded and standing water was common. The very poorly to imperfectly drained Organic soils had hydric to hygric moisture levels and nutrient levels were mesotrophic. Surface substrate cover was primarily organic matter (79% mean) with substantial areas of standing water (20% mean) and small amounts of decaying wood (1% mean). *Salix petiolaris* cover was approximately 14% (0.5 to 30% range) with generally lesser amounts of other willows including *Salix pedicellaris, Salix planifolia, Salix candida, Salix bebbiana,* and *Salix pseudomonticola.* The herb/graminoid was dominated by *Carex diandra* cover (37%) and *Calamagrostis stricta* (11%). Other graminoids may include *Carex chordorrhiza, Agrostis scabra, Calamagrostis canadensis, Muhlenbergia glomerata,* and *Poa interior.* The herb layer was sparse but included *Potentilla norvegica, Potentilla palustris, Epilobium palustre,* and *Equisetum fluviatile.* Although there was only trace amounts of *Salix petiolaris* cover at Plot # 16 it was included in this grouping based on species constancy. *Salix pedicellaris* commonly occurred in association with *S. petiolaris* but it was the dominant willow species at this plot. Additional sampling may have resulted in the formation of a separate *Salix pedicellaris* dominated plant community type.

Class: Shrubland
Subclass: Deciduous Shrubland
Group: Cold-deciduous shrubland
Subgroup: Natural/Semi-natural cold-deciduous shrubland
Formation: Temporarily flooded cold-deciduous shrubland
Alliance: *Salix petiolaris - Salix* spp. Temporarily Flooded Shrubland Alliance
Association: *Salix petiolaris / Carex diandra - Calamagrostis stricta* Shrubland
Unique Identifier: n/a
Classification Confidence Level: 2 (Moderate) Moderately good correlation of plot data with the published literature for the type and occurs within the known geographical range.

Dominant Species: *Salix petiolaris, Salix pedicellaris, Calamagrostis stricta, Carex diandra*
Co-Dominant Species: *Salix candida, Salix planifolia, Carex chordorrhiza*
Diagnostic Species: *Salix petiolaris, Salix candida, Salix pedicellaris, Potentilla norvegica, Potentilla palustris, Carex diandra, Calamagrostis stricta, Agrostis scabra*

Literature Review:

Thompson and Hansen (2002) described a *Salix petiolaris / Carex atherodes* Community Type that was a major community in the Central Parkland Subregion. This type occurred in sloughs, depressional wetlands and wet meadows. It often forms a narrow band of vegetation between open water and/or sedges, and drier wetland communities. Water tables were typically within 1m of the ground surface throughout the growing season. Common species in the shrub layer included *Salix petiolaris* and *Salix bebbiana,* and common forbs included *Potentilla norvegica, Geum macrophyllum, Potentilla norvegica,* and *Scutellaria galericulata.* There were no species in common in the graminoid layer although sedges dominated both and species of the genus *Poa* were present in both as well.

NatureServe (2004) lists a *Salix petiolaris - (Betula pumila) / Spartina pectinata - Carex pellita* Shrubland (CEGL002434) that occurred in the aspen parkland region of the upper midwestern United States and Canada, particularly in southeastern Manitoba (Greenall 1996). This type occurred on poorly drained sites

Table 40. Summary of plot data and descriptive statistics for the *Salix petiolaris / Carex diandra - Calamagrostis stricta* community type (n=3).

Strata	Code	Species	Plots P13	Plots P16	Plots P31	Mean	SE	Constancy	Prominence
G	CAREDIA	*Carex diandra*	20.0	40.0	50.0	36.7	8.8	100.0	60.6
G	CALASTR	*Calamagrostis stricta*	12.0	0.1	20.0	10.7	5.8	100.0	32.7
S3	SALIPED	*Salix pedicellaris*	2.0	15.0	0.0	5.7	4.7	66.7	19.4
S1	SALIPET	*Salix petiolaris*	0.0	0.0	30.0	10.0	10.0	33.3	18.3
S2	SALIPET	*Salix petiolaris*	10.0	0.0	0.0	3.3	3.3	33.3	10.5
S3	SALIPLA	*Salix planifolia*	0.0	0.0	4.0	1.3	1.3	33.3	6.7
G	CARECHO	*Carex chordorrhiza*	4.0	0.0	0.0	1.3	1.3	33.3	6.7
S2	SALIPED	*Salix pedicellaris*	0.0	0.0	3.0	1.0	1.0	33.3	5.8
S2	SALICAN	*Salix candida*	0.1	0.0	1.0	0.4	0.3	66.7	4.9
S2	SALIPLA	*Salix planifolia*	2.0	0.0	0.0	0.7	0.7	33.3	4.7
E	EPIPHYT	*Epiphyte* spp.	0.0	0.0	1.0	0.3	0.3	33.3	3.3
S3	SALIBEB	*Salix bebbiana*	0.0	0.0	1.0	0.3	0.3	33.3	3.3
H	EPILPAL	*Epilobium palustre*	0.0	0.5	0.0	0.2	0.2	33.3	2.4
S3	SALIPET	*Salix petiolaris*	0.0	0.5	0.0	0.2	0.2	33.3	2.4
H	EQUIFLU	*Equisetum fluviatile*	0.0	0.5	0.0	0.2	0.2	33.3	2.4
H	POTENOR	*Potentilla norvegica*	0.1	0.0	0.1	0.1	0.0	66.7	2.1
H	POTEPAL	*Potentilla palustris*	0.1	0.0	0.1	0.1	0.0	66.7	2.1
G	AGROSCA	*Agrostis scabra*	0.1	0.1	0.0	0.1	0.0	66.7	2.1
S3	BETUPUM	*Betula pumila*	0.0	0.0	0.1	0.0	0.0	33.3	1.1
G	CALACAN	*Calamagrostis canadensis*	0.1	0.0	0.0	0.0	0.0	33.3	1.1
G	MUHLGLO	*Muhlenbergia glomerata*	0.0	0.1	0.0	0.0	0.0	33.3	1.1
S2	SALIBEB	*Salix bebbiana*	0.1	0.0	0.0	0.0	0.0	33.3	1.1
S2	BETUPUM	*Betula pumila*	0.1	0.0	0.0	0.0	0.0	33.3	1.1
G	POAINTE	*Poa interior*	0.0	0.0	0.1	0.0	0.0	33.3	1.1
S3	POPUBAL	*Populus balsamifera*	0.0	0.0	0.1	0.0	0.0	33.3	1.1
H	POLYAMP	*Polygonum amphibium*	0.1	0.0	0.0	0.0	0.0	33.3	1.1
H	SCUTGAL	*Scutellaria galericulata*	0.0	0.1	0.0	0.0	0.0	33.3	1.1
S3	SALIPSE	*Salix pseudomonticola*	0.0	0.0	0.1	0.0	0.0	33.3	1.1
H	GEUMMAC	*Geum macrophyllum*	0.0	0.0	0.1	0.0	0.0	33.3	1.1
H	CICUMAC	*Cicuta maculata*	0.0	0.1	0.0	0.0	0.0	33.3	1.1
S2	BETUPAP	*Betula papyrifera*	0.0	0.0	0.1	0.0	0.0	33.3	1.1

with a range of soil textures including loamy fine sand to sandy clay loam. *Populus tremuloides* and *Populus balsamifera* saplings or small groves may be present. Dominant shrubs include *Dasiphora fruticosa* spp. *floribunda (= Pentaphylloides floribunda), Salix discolor, Salix petiolaris (= Salix gracilis),*and on some sites *Betula pumila* and *Spiraea alba*. Important grasses include *Spartina pectinata, Calamagrostis stricta, Calamagrostis canadensis, Andropogon gerardii*, and *Muhlenbergia richardsonis*. Common sedges include *Carex buxbaumii, Carex pellita (= Carex lanuginosa), Carex sartwellii*, and *Carex tetanica*. Commonly there was moderate cover of typical wet prairie forbs. Similarity ratings for related plant community types are provided in Table 41.

Table 41. Correlation table of plant community types with similarity ratings for the *Salix petiolaris / Carex diandra - Calamagrostis stricta* type.

Similar Types	Similarity Rating	Comments
Salix petiolaris / Carex atherodes CT (Thompson and Hansen 2002)	2	This was a related type of the Central Parkland, Mixedgrass and Dry Mixedgrass Subregions. It occupies similar ecological niches but has significant differences in floristics.
Salix petiolaris - (Betula pumila) / Spartina pectinata - Carex pellita Shrubland (CEGL002434) NatureServe (2004)	3	Although this was a *Salix petiolaris* type that occurred in the central parkland there were significant differences in community structure and floristics.

3.3.2.4 *Alnus viridis* spp. *crispa - Prunus pensylvanica / Aralia nudicaulis* Shrubland

Green Alder – Pin Cherry / Sarsaparilla Shrubland

Small patches of alder were observed in the Holmes Crossing Sandhills Ecological Reserve and North Buck Lake study areas. Often these occurred as irregular shaped communities in small forest openings. The one plot completed in the North Buck Lake study area occurred on a gentle upper slope (4%slope gradient) adjacent to a stand of aspen and jack pine. Soils were well-drained fine sands with submesic moisture levels and a mesotrophic nutrient regime. The surface substrate cover was predominantly organic matter (95%) with some decaying wood 3%, and exposed mineral soil at 2%. The shrub layer cover was very dense and was dominated by *Alnus viridis* (60%) and *Prunus pensylvanica* (15%) (Table 42). Other species that were co-dominant in the S1 shrub layer included *Amelanchier alnifolia, Picea glauca,* and *Prunus virginiana. Vaccinium myrtilloides* and *Rubus idaeus* were also present. The herb layer was clearly dominated by *Aralia nudicaulis* (30% cover) with only trace amounts of *Epilobium angustifolium, Fragaria virginiana, Equisetum laevigatum, Campanula rotundifolia* and other species.

Class: Shrubland
Subclass: Deciduous Shrubland
Group: Cold-deciduous shrubland
Subgroup: Natural/Semi-natural cold-deciduous shrubland
Formation: Subalpine or subpolar cold-deciduous shrubland
Alliance: *Alnus viridis* spp. *crispa / Carex pensylvanica* Shrubland
Association: *Alnus viridis* spp. *crispa - Prunus pensylvanica / Aralia nudicaulis* Shrubland
Unique Identifier: n/a
Classification Confidence Level: 3 (Weak) This community type was not well defined by this study and only one plot was completed. There were reports of similar types noted in the literature review and the geographical range of this type was unknown.

Dominant Species: *Alnus viridis, Prunus pensylvanica, Vaccinium myrtilloides, Aralia nudicaulis*
Co-Dominant Species: *Amelanchier alnifolia, Picea glauca, Prunus virginiana, Rubus idaeus*
Diagnostic Species: *Alnus viridis, Prunus pensylvanica, Vaccinium myrtilloides, Aralia nudicaulis*

Table 42. Summary of plot data and descriptive statistics for the *Alnus viridis* spp. *crispa* - *Prunus pensylvanica* / *Aralia nudicaulis* community type (n=1).

			Plot
Strata	**Code**	**Species**	**P22**
S1	ALNUVIR	*Alnus viridis*	60.0
H	ARALNUD	*Aralia nudicaulis*	30.0
S3	VACCMYR	*Vaccinium myrtilloides*	20.0
S1	PRUNPEN	*Prunus pensylvanica*	15.0
S2	RUBUIDA	*Rubus idaeus*	10.0
S1	AMELALN	*Amelanchier alnifolia*	6.0
S2	PRUNVIR	*Prunus virginiana*	4.0
S1	PICEGLA	*Picea glauca*	2.0
G	CARESIC	*Carex siccata*	1.0
S3	ROSAACI	*Rosa acicularis*	1.0
H	GALIBOR	*Galium boreale*	0.1
S3	VACCVIT	*Vaccinium vitis-idaea*	0.1
H	EPILANG	*Epilobium angustifolium*	0.1
H	FRAGVIR	*Fragaria virginiana*	0.1
H	EQUILAE	*Equisetum laevigatum*	0.1
S1	SALIBEB	*Salix bebbiana*	0.1
H	CAMPROT	*Campanula rotundifolia*	0.1
H	ANEMMUL	*Anemone multifida*	0.1
G	SCHIPUR	*Schizachne purpurascens*	0.1
M	MOSSES$$	*Moss* spp.	0.1
G	ELYMINN	*Leymus innovatus*	0.1
H	VIOLREN	*Viola renifolia*	0.1
H	PYROCHL	*Pyrola chlorantha*	0.1

Literature Review:

Nelson *et al*. (1989) described a Dry Meadow Community Type for Holmes Crossing that occured on steep south-facing dune slopes that had rapidly drained soils and received intense insolation. The shrub layer was open with only 5% total cover consisting primarily of *Alnus viridis* spp. *crispa* (2% cover). Important species in the understorey were *Smilacina stellata* (20%), *Arctostaphylos uva-ursi* (5%), and *Solidago multiradiata* (5%). Also occurring in the herb/graminoid layer was *Artemisia campestris*, *Anemone multifida*, *Carex* spp., *Elymus trachycaulus* and *Oryzopsis pungens*. NatureServe (2004) listed no similar types. Similarity ratings for related plant community types are provided in Table 43.

Table 43. Correlation table of plant community types with similarity ratings for the *Alnus viridis* spp. *crispa* - *Prunus pensylvanica* / *Aralia nudicaulis* type.

Similar Types	Similarity Rating	Comments
Dry Meadow CT (Nelson *et al*. 1989)	3	This was a drier more open plant community type with a quite different species composition.

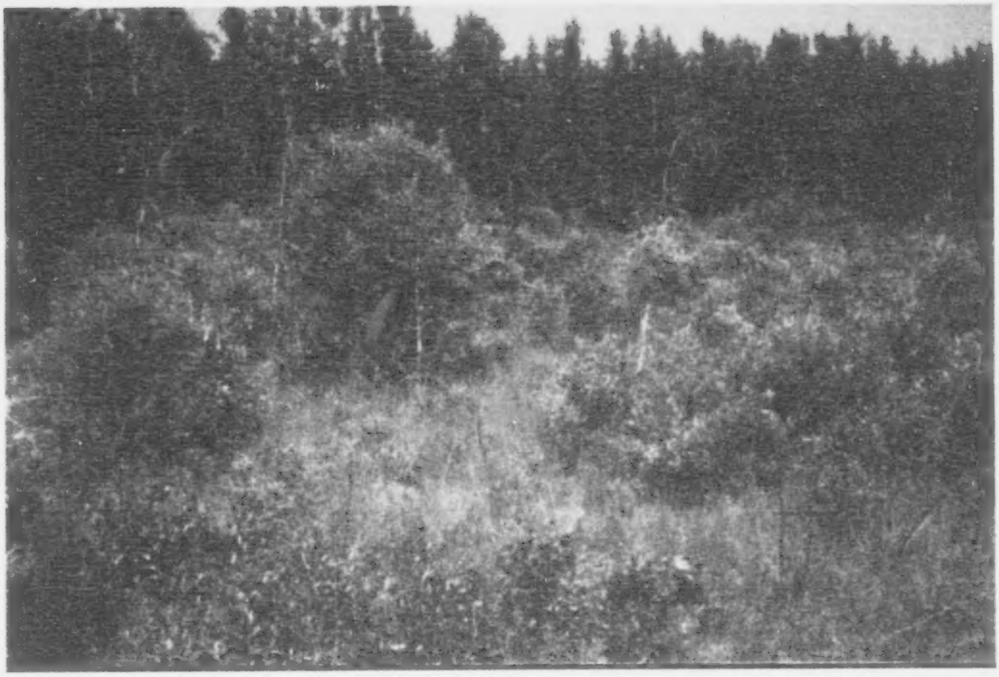


Plate 20. *Salix petiolaris / Carex diandra - Calamagrostis stricta* Shrubland (P31).

Plate 21. *Alnus viridis* spp. *crispa* - *Prunus pensylvanica / Aralia nudicaulis* Shrubland (P22).

3.3.2.5 *Amelanchier alnifolia / Arctostaphylos uva-ursi / Oryzopsis pungens* Dwarf-shrubland

Saskatoon / Common Bearberry / Northern Rice Grass Dwarf-shrubland

This dwarf-shrubland community was relatively common in the Holmes Crossing Sandhills Ecological Reserve where five (5) plots were completed (Table 44). It was encountered less frequently in the North Buck Lake study area and one (1) plot was completed there. Sites were typically convex in profile and located on upper slopes and less frequently on mid-slope and crest positions. The mean slope gradient of the sites sampled was 24% ranging between 8% and 40%. Aspects were also variable but were predominately southeast to southwest and moderate levels of insolation. Soils were fine sands, which were rapidly to well drained with subxeric to submesic moisture levels. The soil nutrient regime was mesotrophic. Surface substrate cover was mainly organic matter (86% mean) and exposed soil (13% mean) with a trace of decaying wood. *Arctostaphylos uva-ursi* cover (35% mean) dominates this community. Other important species include *Prunus virginiana* (4%), *Amelanchier alnifolia* (2%), *Oryzopsis pungens* (6%), *Aster laevis, Galium boreale, Solidago spathulata, Carex siccata, Festuca saximontana, Astragalus striatus,* and *Elymus trachycaulus.*

Class: Dwarf-shrubland
Subclass: Evergreen dwarf-shrubland
Group: Needle-leaved or microphyllous evergreen dwarf-shrubland
Subgroup: Natural/Semi-natural needle-leaved or microphyllous evergreen dwarf-shrubland
Formation: Creeping or matted needle-leaved or microphyllous evergreen dwarf-shrubland
Alliance: *Arctostaphylos uva-ursi* Dwarf-shrubland Alliance
Association: *Amelanchier alnifolia / Arctostaphylos uva-ursi / Oryzopsis pungens* Dwarf-shrubland
Unique Identifier: Listed in Alberta as CEAB000029.
Classification Confidence Level: 1 (Strong) This type was relatively common in both study areas and a total of six plots were completed. It was a reported type and was known to occur in the Dry Mixedwood Natural Subregion.

Dominant Species: *Arctostaphylos uva-ursi, Oryzopsis pungens*
Co-Dominant Species: *Amelanchier alnifolia, Prunus virginiana, Astragalus striatus, Galium boreale, Solidago spathulata, Elymus trachycaulus, Carex siccata*
Diagnostic Species: *Amelanchier alnifolia, Arctostaphylos uva-ursi, Aster laevis, Galium boreale, Solidago spathulata, Carex siccata, Festuca saximontana, Oryzopsis pungens*

Literature Review:

Allen (2004) lists an *Amelanchier alnifolia / Arctostaphylos uva-ursi / Oryzopsis pungens* community type (CEAB000029) that occurred on level, upland pockets in the Dry Mixedwood Natural Subregion. Stands were usually small and surrounded by jack pine or aspen stands. This community was the equivalent of the DMA7 type identified in Willoughby *et al.* (1997) and was provincially ranked S2S3. Timoney and Robinson (1998) noted that *Oryzopsis pungens* grasslands occurred in Ft. Assiniboine Sandhills Wildland Park. They referred to a *Pinus banksiana / Arctostaphylos uva-ursi / Oryzopsis pungens* community type. This community generally occurred as a savannah or parkland mosaic with dry jack pine forest.

Allen *et al.* (2002) reported an *Amelanchier alnifolia / Arctostaphylos uva-ursi / Oryzopsis pungens* community type that occurred in the La Butte Creek Wildland Provincial Park located north of Lake Athabasca. Ground cover of this type was very similar to the current type. *Amelanchier alnifolia, Arctostaphylos uva-ursi,* and *Oryzopsis pungens* occurred at trace, 50% and 25% ground cover, respectively. There was generally a good fit of species between the current type and this community type.

Table 44. Summary of plot data and descriptive statistics for the *Amelanchier alnifolia / Arctostaphylos uva-ursi / Oryzopsis pungens* community type (n=6).

			Plot									
Strata	**Code**	**Species**	**P02**	**P04**	**P10**	**P14**	**P20**	**P57**	**Mean**	**SE**	**Constancy**	**Prominence**
S3	ARCTUVA	*Arctostaphylos uva-ursi*	30.0	15.0	25.0	37.0	30.0	70.0	34.5	7.7	100.0	58.7
G	ORYZPUN	*Oryzopsis pungens*	3.0	2.0	9.0	12.0	4.0	4.0	5.7	1.6	100.0	23.8
H	SOLISPA	*Solidago spathulata*	0.0	10.0	4.0	7.0	5.0	0.0	4.3	1.6	66.7	17.0
G	CARESIC	*Carex siccata*	0.0	0.1	15.0	8.0	0.0	0.5	3.9	2.6	66.7	16.2
S3	PRUNVIR	*Prunus virginiana*	0.0	0.0	6.0	12.0	7.0	0.0	4.2	2.0	50.0	14.4
S3	AMELALN	*Amelanchier alnifolia*	0.0	3.0	2.0	5.0	3.0	0.5	2.3	0.8	83.3	13.7
G	ELYMTRA	*Elymus trachycaulus*	0.5	2.0	4.0	1.0	3.0	0.0	1.8	0.6	83.3	12.1
H	ASTRSTR	*Astragalus striatus*	0.0	0.0	4.0	9.0	2.0	0.0	2.5	1.5	50.0	11.2
H	GALIBOR	*Galium boreale*	0.5	1.0	3.0	1.0	2.0	0.0	1.3	0.4	83.3	10.2
H	ASTELAE	*Aster laevis*	2.0	3.0	2.0	0.0	0.5	0.0	1.3	0.5	66.7	9.1
H	ARTECAM	*Artemisia campestris*	0.0	1.0	0.5	2.0	2.0	0.1	0.9	0.4	83.3	8.8
G	CAREUMB	*Carex umbellata*	0.0	1.0	0.5	3.0	2.0	0.0	1.1	0.5	66.7	8.5
G	FESTSAX	*Festuca saximontana*	0.0	0.5	0.5	0.0	3.0	2.0	1.0	0.5	66.7	8.2
S3	ROSAACI	*Rosa acicularis*	0.0	0.0	0.0	5.0	2.0	0.1	1.2	0.8	50.0	7.7
H	FRAGVIR	*Fragaria virginiana*	0.0	0.0	3.0	2.0	2.0	0.0	1.2	0.5	50.0	7.6
L	CLADMIT	*Cladina mitis*	0.0	0.0	0.0	0.0	2.0	8.0	1.7	1.3	33.3	7.5
L	CLADRAN	*Cladina rangiferina*	20.0	0.0	0.0	0.0	0.0	0.0	3.3	3.3	16.7	7.5
H	LATHOCH	*Lathyrus ochroleucus*	2.0	2.0	0.0	2.0	0.0	0.0	1.0	0.4	50.0	7.1
H	MAIACAN	*Maianthemum canadense*	2.0	0.0	0.0	0.0	0.0	2.0	0.7	0.4	33.3	4.7
G	CAREPEN	*Carex pensylvanica*	0.0	0.0	0.0	0.0	8.0	0.0	1.3	1.3	16.7	4.7
H	APOCAND	*Apocynum androsaemifolium*	0.0	6.0	0.0	0.0	0.0	0.0	1.0	1.0	16.7	4.1
S3	SYMPOCC	*Symphoricarpos occidentalis*	0.0	0.0	0.5	2.0	0.0	0.0	0.4	0.3	33.3	3.7
H	SMILSTE	*Smilacina stellata*	0.1	0.0	0.0	0.0	1.0	0.0	0.2	0.2	33.3	2.5
H	EPILANG	*Epilobium angustifolium*	0.0	0.0	0.0	0.0	0.0	2.0	0.3	0.3	16.7	2.4
H	SELADEN	*Selaginella densa*	0.0	0.0	0.0	2.0	0.0	0.0	0.3	0.3	16.7	2.4
S1	AMELALN	*Amelanchier alnifolia*	2.0	0.0	0.0	0.0	0.0	0.0	0.3	0.3	16.7	2.4
S2	PRUNPEN	*Prunus pensylvanica*	2.0	0.0	0.0	0.0	0.0	0.0	0.3	0.3	16.7	2.4
S2	AMELALN	*Amelanchier alnifolia*	2.0	0.0	0.0	0.0	0.0	0.0	0.3	0.3	16.7	2.4
H	SOLIMIS	*Solidago missouriensis*	0.5	0.0	0.5	0.0	0.0	0.0	0.2	0.1	33.3	2.4
L	CLADONI	*Cladonia* spp.	0.0	0.0	0.0	1.0	0.0	0.0	0.2	0.2	16.7	1.7
M	POLYPIL	*Polytrichum piliferum*	0.0	0.0	0.0	0.0	0.0	1.0	0.2	0.2	16.7	1.7
H	LILIPHI	*Lilium philadelphicum*	0.0	0.5	0.0	0.0	0.0	0.0	0.1	0.1	16.7	1.2
H	EQUILAE	*Equisetum laevigatum*	0.0	0.0	0.5	0.0	0.0	0.0	0.1	0.1	16.7	1.2
H	ANDRSEP	*Androsace septentrionalis*	0.0	0.5	0.0	0.0	0.0	0.0	0.1	0.1	16.7	1.2
H	TRIEBOR	*Trientalis borealis*	0.0	0.0	0.0	0.0	0.0	0.5	0.1	0.1	16.7	1.2
S3	VACCMYR	*Vaccinium myrtilloides*	0.0	0.0	0.0	0.0	0.0	0.5	0.1	0.1	16.7	1.2
S3	VACCVIT	*Vaccinium vitis-idaea*	0.5	0.0	0.0	0.0	0.0	0.0	0.1	0.1	16.7	1.2
S2	ROSAACI	*Rosa acicularis*	0.5	0.0	0.0	0.0	0.0	0.0	0.1	0.1	16.7	1.2
G	CAREX$$$	*Carex* spp	0.1	0.1	0.0	0.0	0.0	0.0	0.0	0.0	33.3	1.1
L	PELTMAL	*Peltigera malacea*	0.0	0.0	0.0	0.0	0.0	0.1	0.0	0.0	16.7	0.5
H	VICIAME	*Vicia americana*	0.1	0.0	0.0	0.0	0.0	0.0	0.0	0.0	16.7	0.5
H	THALVEN	*Thalictrum venulosum*	0.0	0.0	0.1	0.0	0.0	0.0	0.0	0.0	16.7	0.5
L	PELTCAN	*Peltigera canina*	0.1	0.0	0.0	0.0	0.0	0.0	0.0	0.0	16.7	0.5
S2	PRUNVIR	*Prunus virginiana*	0.1	0.0	0.0	0.0	0.0	0.0	0.0	0.0	16.7	0.5
H	CAMPROT	*Campanula rotundifolia*	0.0	0.1	0.0	0.0	0.0	0.0	0.0	0.0	16.7	0.5
G	AGROSCA	*Agrostis scabra*	0.0	0.0	0.0	0.0	0.0	0.1	0.0	0.0	16.7	0.5
H	ACHIMIL	*Achillea millefolium*	0.1	0.0	0.0	0.0	0.0	0.0	0.0	0.0	16.7	0.5
M	POLYTRI	*Polytrichum* spp.	0.1	0.0	0.0	0.0	0.0	0.0	0.0	0.0	16.7	0.5
H	MELALIN	*Medicago lupulina*	0.0	0.0	0.0	0.0	0.0	0.1	0.0	0.0	16.7	0.5
H	ERIGGLA	*Erigeron glabellus*	0.0	0.1	0.0	0.0	0.0	0.0	0.0	0.0	16.7	0.5

Wheatley and Bentz (2002) described an *Arctostaphylos uva-ursi* Dwarf-Shrubland Alliance type for the Central Parkland Natural Subregion. It occurred on sandy upland plains on poorly developed soils that were rapidly drained with xeric moisture conditions and submesotrophic nutrients levels. *Arctostaphylos uva-ursi* was the dominant plant and associates include *Juniperus horizontalis, Heterotheca villosa, Solidago missouriensis, Artemisia frigida, Artemisia campestris, Calamovilfa longifolia* and *Agropyron dasystachyum*.

Wildlands Ecological Consulting Ltd. (2004) described an *Arctostaphylos uva-ursi* Dwarf-shrubland that occupied a similar ecological niche in the Dry Mixedgrass and Mixedgrass Natural Subregions. *Arctostaphylos uva-ursi* cover formed dense mats with 63% ground cover. Other plant species with relatively high percent cover included *Juniperus communis, Hedysarum boreale,* and *Hymenoxys acaulis.* Other important species were *Juniperus horizontalis, Pascopyrum smithii, Koeleria macrantha, Eriogonum flavum, Achillea millefolium,* and *Comandra umbellatum.*

NatureServe describes an *Arctostaphylos uva-ursi / Solidago multiradiata* Dwarf-shrubland type (CEGL005832). This community potentially occurred in Alberta and was common in Glacier National Park of Montana. It occurred in the subalpine and lower alpine areas often associated with *Pinus albicaulis* stands or krummholz patches of *Abies lasiocarpa* and *Pinus flexilis*. *Arctostaphylos uva-ursi* was variable ranging between 10% and 75% cover. Other constant species include *Dasiphora fruticosa* spp. *floribunda* and *Juniperus communis.* Graminoids cover included trace amounts of *Calamagrostis koelerioides, Festuca idahoensis*, and *Festuca campestris.* Forbs with high constancy include *Solidago multiradiata, Hedysarum sulphurescens, Minuartia obtusiloba (= Arenaria obtusiloba), Potentilla diversifolia, Campanula rotundifolia, Galium boreale, Cerastium arvense, Achillea millefolium, Pulsatilla patens* spp. *multifida (= Anemone patens), Bupleurum americanum, Sedum lanceolatum*, and *Antennaria umbrinella*. Similarity ratings for related plant community types are provided in Table 45.

Table 45. Correlation table of plant community types with similarity ratings for the *Amelanchier alnifolia / Arctostaphylos uva-ursi / Oryzopsis pungens* type.

Similar Types	Similarity Rating	Comments
Amelanchier alnifolia / Arctostaphylos uva-ursi / Oryzopsis pungens CT (CEAB000029) (Willoughby *et al.* 1997, Allen 2004)	1	Based on dominant species this was a very similar community type that was found in the Dry Mixedwood Natural Subregion.
Amelanchier alnifolia / Arctostaphylos uva-ursi / Oryzopsis pungens CT (Allen *et al.* 2002)	1(2)	Appears to be a very similar type but it was reported to occur on bedrock outcrops occupying similar sites.
Pinus banksiana / Arctostaphylos uva-ursi / Oryzopsis pungens CT (Timoney and Robinson 1998)	2	The grassland portion of this community mosaic was likely equivalent to the current type. However, no details were provided on species composition and percent covers.
Arctostaphylos uva-ursi Dwarf-Shrubland Alliance (Wheatley and Bentz 2002)	2	Occurred in the parkland on sandy sites and has very similar species composition.
Arctostaphylos uva-ursi Dwarf-shrubland (Wildlands Ecological Consulting Ltd. 2004)	3	Similar cover of *Arctostaphylos uva-ursi* otherwise the species composition was quite different from the present classification.
Arctostaphylos uva-ursi / Solidago multiradiata Dwarf-shrubland type (CEGL005832) (NatureServe 2004)	3	Although *Arctostaphylos uva-ursi* was dominant in this type there were few other similarities because it was a subalpine and lower alpine community with quite different species composition.

3.3.2.6 *Arctostaphylos uva-ursi / Calamovilfa longifolia* Dwarf-shrubland
Common Bearberry / Sand Grass Dwarf-shrubland

This type does not appear to be common in the two study areas and only one plot was completed in the Holmes Crossing Sandhills Ecological Reserve (Table 46). This site was located on a mid-slope position that was south-facing and affected by insolation. The slope gradient at this plot was 25%. Soils were rapidly to well drained with subxeric moisture levels and a mesotrophic nutrient regime. Surface substrates were organic (89%) mineral soil 10%, and minor amounts of decaying wood (1%). Both *Arctostaphylos uva-ursi* and *Calamovilfa longifolia* occured at 50 % cover for each species. The relatively dense cover of *Calamovilfa longifolia* makes this community quite recognisable while the high cover of *Arctostaphylos uva-ursi* was characteristic but less obvious. Stands occur in openings that may have scattered *Pinus banksiana* and *Populus tremuloides* tree cover. Other shrub cover was less than 10% and included *Amelanchier alnifolia, Rosa acicularis,* and *Prunus* spp. *Calamovilfa longifolia* was dominant in the herb/graminoid layer although common species may include *Oryzopsis pungens, Lathyrus ochroleucus, Astragalus striatus, Galium boreale, Fragaria virginiana,* and *Astragalus robbinsii.*

Class: Dwarf-shrubland
Subclass: Evergreen dwarf-shrubland
Group: Needle-leaved or microphyllous evergreen dwarf-shrubland
Subgroup: Natural/Semi-natural needle-leaved or microphyllous evergreen dwarf-shrubland
Formation: Xeric Temperate or Subpolar Creeping or matted needle-leaved or microphyllous evergreen dwarf-shrubland
Alliance: *Arctostaphylos uva-ursi* Dwarf-shrubland Alliance
Association: *Arctostaphylos uva-ursi / Calamovilfa longifolia* Dwarf-shrubland
Unique Identifier: n/a
Classification Confidence Level: 1 (Weak) Only one stand was encountered during sampling and it was not well documented in the literature. Geographical range of this community type was unknown.

Dominant Species: *Arctostaphylos uva-ursi, Calamovilfa longifolia*
Co-Dominant Species: *Pinus banksiana, Populus tremuloides, Amelanchier alnifolia, Rosa acicularis, Oryzopsis pungens*
Diagnostic Species: *Arctostaphylos uva-ursi, Calamovilfa longifolia*

Literature Review:

The *Amelanchier alnifolia / Arctostaphylos uva-ursi / Oryzopsis pungens* community type (CEAB000029) was currently tracked in Alberta (Allen 2004). This type was similar but lacks the high cover of *Calamovilfa longifolia*. The current classification was, however, expected to fall within the *Arctostaphylos uva-ursi* Dwarf-Shrubland Alliance described by Wheatley and Bentz (2002). This latter type occurred in the Central Parkland Natural Subregion on sandy upland plains and included *Arctostaphylos uva-ursi, Juniperus horizontalis, Heterotheca villosa, Solidago missouriensis, Artemisia frigida, Artemisia campestris, Calamovilfa longifolia* and *Agropyron dasystachyum*. Timoney and Robinson (1998) noted that the *Calamovilfa longifolia* subxeric grassland was uncommon in the Ft. Assiniboine Sandhills Wildland Park. It occurrence here was considered to be a small range extension for this grass species.

The *Arctostaphylos uva-ursi / Calamovilfa longifolia* Dwarf-shrubland type described here was similar to a *Juniperus horizontalis / Calamovilfa longifolia - Carex pensylvanica* spp. *heliophila* type reported by Coenen (2003). This community occurred on partially stabilised dunes in the Wainwright area and shares some similarity in floristics to the current community type. The main differences with the Wainwright community were the lower cover of *Arctostaphylos uva-ursi* (3%) and presence of *Juniperus horizontalis, Sporobolus cryptandrus*, *Carex pensylvanica* and absence of species present in the Boreal Sand Dune type.

Table 46. Summary of plot data and descriptive statistics for the *Arctostaphylos uva-ursi / Calamovilfa longifolia* Dwarf-shrubland (n=1).

			Plot
Strata	**Code**	**Species**	**P27**
S3	ARCTUVA	*Arctostaphylos uva-ursi*	50.0
G	CALALON	*Calamovilfa longifolia*	50.0
T1	PINUBAN	*Pinus banksiana*	10.0
S3	AMELALN	*Amelanchier alnifolia*	4.0
G	ORYZPUN	*Oryzopsis pungens*	2.0
S2	POPUTRE	*Populus tremuloides*	2.0
S3	ROSAACI	*Rosa acicularis*	2.0
H	LATHOCH	*Lathyrus ochroleucus*	1.0
S1	PINUBAN	*Pinus banksiana*	1.0
H	ASTRSTR	*Astragalus striatus*	1.0
H	GALIBOR	*Galium boreale*	0.1
H	FRAGVIR	*Fragaria virginiana*	0.1
H	ASTRROB	*Astragalus robbinsii*	0.1
S3	SYMPOCC	*Symphoricarpos occidentalis*	0.1
H	APOCAND	*Apocynum androsaemifolium*	0.1
S3	PRUNPEN	*Prunus pensylvanica*	0.1
H	ERIGGLA	*Erigeron glabellus*	0.1
H	CAMPROT	*Campanula rotundifolia*	0.1
G	CAREUMB	*Carex umbellata*	0.1
L	CLADMIT	*Cladina mitis*	0.1
H	SOLISPA	*Solidago spathulata*	0.1
H	SMILSTE	*Smilacina stellata*	0.1
S3	PRUNVIR	*Prunus virginiana*	0.1
G	ELYMTRA	*Elymus trachycaulus*	0.1
H	EQUILAE	*Equisetum laevigatum*	0.1
H	ASTELAE	*Aster laevis*	0.1
H	ANEMMUL	*Anemone multifida*	0.1
L	CLADONI	*Cladonia* spp.	0.1
G	FESTSAX	*Festuca saximontana*	0.1

Coenen (2003) also reported a *Calamovilfa longifolia – Sporobolus cryptandrus – Carex Siccata* type for the Wainwright sand dunes. It occurred on sand dunes with some active sand movement, however shared few similarities in floristics in comparison to the current classification.

Wildlands Ecological Consulting Ltd. (2004) described an *Arctostaphylos uva-ursi* Dwarf-shrubland community present in the Dry Mixedgrass and Mixedgrass Natural Subregions. The high percent cover of *Arctostaphylos uva-ursi* was common to both types yet the species compositions were quite different. Common species in this type include *Juniperus communis, Hedysarum boreale, Hymenoxys acaulis, Juniperus horizontalis, Pascopyrum smithii, Koeleria macrantha, Eriogonum flavum, Achillea millefolium,* and *Comandra umbellatum.* A second type reported on that study was *Calamovilfa longifolia - Hesperostipa comata* Herbaceous Vegetation. *Calamovilfa longifolia* was dominant but *Arctostaphylos uva-ursi* was not recorded for this type. Adams *et al.* (1997) described a similar *Calamovilfa longifolia - Hesperostipa comata* type that occurred near Suffield, Alberta.

No similar community types were listed by NatureServe (2004) or by Allen (2004). Similarity ratings for related plant community types are provided in Table 47.

Table 47. Correlation table of plant community types with similarity ratings for the *Arctostaphylos uva-ursi / Calamovilfa longifolia* type.

Similar Types	Similarity Rating	Comments
Amelanchier alnifolia / Arctostaphylos uva-ursi / Oryzopsis pungens CT (CEAB000029) (Allen 2004)	3	*Calamovilfa longifolia* was not a dominant species but this was a related type of community in the Dry Mixedwood Natural Subregion.
Arctostaphylos uva-ursi Dwarf-Shrubland Alliance (Wheatley and Bentz 2002)	2	Occurred in the parkland on sandy sites and has very similar species composition.
Calamovilfa longifolia CT (Timoney and Robinson 1998)	1(2)	Based on the proximity of the study areas and dominant species present in this type of grassland they were expected to be the same or closely related types.
Juniperus horizontalis / Calamovilfa longifolia - Carex pensylvanica spp. *heliophila* CT (Coenen 2003)	2	Similar floristics but *Arctostaphylos uva-ursi* cover was much lower in this type and the other two indicator species were not recorded on the current study.
Calamovilfa longifolia – Sporobolus cryptandrus – Carex Siccata CT (Coenen 2003)	3	*Calamovilfa longifolia* was a dominant species as well but *Arctostaphylos uva-ursi* was not and there were other significant differences in species composition.
Arctostaphylos uva-ursi Dwarf-shrubland (Wildlands Ecological Consulting Ltd. 2004)	3	*Arctostaphylos uva-ursi* cover was dense in both types but otherwise the species composition was quite different from the present classification.
Calamovilfa longifolia - Hesperostipa comata Herbaceous Vegetation (Adams *et al.* 1997, Wildlands Ecological Consulting Ltd. 2004)	3	*Calamovilfa longifolia* was a dominant species but no *Arctostaphylos uva-ursi* was present in this type.
Arctostaphylos uva-ursi / Solidago multiradiata Dwarf-shrubland (CEGL005832) (NatureServe 2004)	3	Although *Arctostaphylos uva-ursi* was dominant in this type there were few other similarities because it was a subalpine and lower alpine community with quite different species composition.

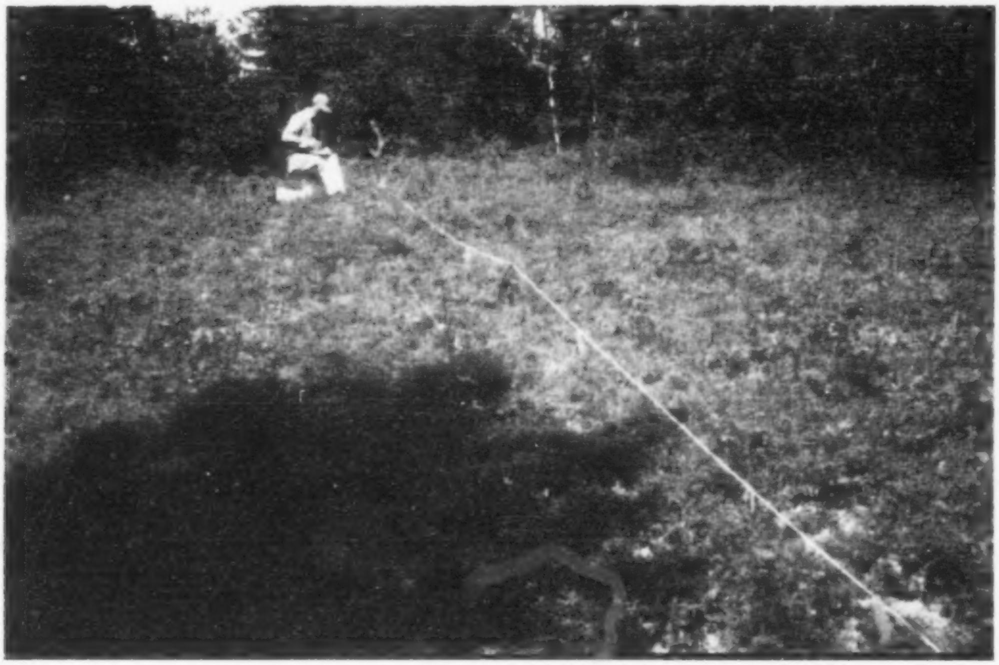


Plate 22. *Arctostaphylos uva-ursi / Oryzopsis pungens* Dwarf Shrubland (P2).

Plate 23. *Arctostaphylos uva-ursi / Calamovilfa longifolia* Dwarf Shrubland (P27).

3.3.1.7 *Picea mariana / Ledum groenlandicum / Sphagnum fuscum Dwarf-shrubland*
Black Spruce / Labrador-tea / Sphagnum Dwarf-shrubland

This was likely a relatively common type and one plot was completed for this community type in the North Buck Lake study area (Table 48). It occurred in an interdune depression where the water table remains close to the surface over the entire year. Soils were Organic with hygric moisture levels and a submesotrophic nutrient regime. There was no tree layer in this community although stunted *Picea mariana* trees, less than 5 m tall, were present in the shrub layers. *Picea mariana* was present in the tall, mid and low shrub layers at 1%, 20%, and 4% cover values, respectively. *Ledum groenlandicum* (80%) and *Vaccinium vitis-idaea* (20%) dominated the low shrub cover. The moss layer was dense, dominated by *Sphagnum fuscum* (80%) and other sphagnum mosses (5%). Other common species included *Oxycoccus microcarpus, Rubus arcticus,* and *Cladina mitis.*

Class: Dwarf-shrubland
Subclass: Evergreen dwarf-shrubland
Group: Needle-leaved or microphyllous evergreen dwarf-shrubland
Subgroup: Natural/Semi-natural needle-leaved or microphyllous evergreen dwarf-shrubland
Formation: Saturated needle-leaved or microphyllous evergreen dwarf-shrubland with a sparse needle-leaved evergreen tree layer
Alliance: *Picea mariana* Saturated Dwarf-shrubland Alliance
Association: *Picea mariana / Ledum groenlandicum / Sphagnum fuscum* Dwarf-shrubland
Unique Identifier:
Classification Confidence Level: 1 (Strong) Common type that was easily identifiable, was well documented, and has a wide geographic distribution throughout the boreal region.

Dominant Species: *Picea mariana, Ledum groenlandicum, Vaccinium vitis-idaea, Sphagnum fuscum*
Co-Dominant Species: *Oxycoccus microcarpus, Rubus arcticus, Cladina mitis*
Diagnostic Species: *Ledum groenlandicum, Oxycoccus microcarpus, Vaccinium vitis-idaea, Rubus arcticus, Sphagnum* spp.

Table 48. Summary of plot data and descriptive statistics for the *Picea mariana / Ledum groenlandicum / Sphagnum fuscum* Dwarf-shrubland community type (n=1).

			Plot
Strata	**Code**	**Species**	**58**
S3	LEDUGRO	*Ledum groenlandicum*	80.0
M	SPHAFUS	*Sphagnum fuscum*	80.0
S3	VACCVIT	*Vaccinium vitis-idaea*	20.0
S2	PICEMAR	*Picea mariana*	20.0
M	SPHAGNU	*Sphagnum* spp.	5.0
L	CLADMIT	*Cladina mitis*	4.0
S3	PICEMAR	*Picea mariana*	4.0
S3	OXYCMIC	*Oxycoccus microcarpus*	3.0
H	RUBUACA	*Rubus arcticus*	2.0
G	ERIOVAG	*Eriophorum vaginatum*	1.0
M	POHLNUT	*Pohlia nutans*	1.0
S1	PICEMAR	*Picea mariana*	1.0
M	MOSSES$$	*Moss* spp.	1.0
L	CLADDEF	*Cladonia deformis*	0.1
M	AULAPAL	*Aulacomnium palustre*	0.1
L	CLADBEL	*Cladonia bellidiflora*	0.1
H	SMILTRI	*Smilacina trifolia*	0.1

Literature Review:

Hermesh (1972) described an interdune wetland type in the Athabasca Lake area that was dominated by *Picea mariana, Larix laricina, Ledum groenlandicum,* and *Sphagnum* spp. These "slacks" may have standing water through the summer but no further details were provided for this community. Allen *et al.* (2003) reported a *Picea mariana / Ledum groenlandicum / Sphagnum fuscum* community type that occurred in the Fidler-Greywillow Provincial Park at Lake Athabasca. This type was considered to be widespread in the region. It was found to occur in small basin bogs, adjacent poor fen complex, and on permafrost islands in a large fen. Allen and Johnson (no date.) described a *Picea mariana / Chamaedaphne calyculata – Kalmia polifolia / Sphagnum* spp. community type from Marguerite Crag and Tail Wildland Park. No details were provided regarding this type other than it occurred in a bog between sand deposits and crag areas. Mackenzie River Basin Committee (1981) identified a *Ledum groenlandicum / Sphagnum* spp. community at Lake Athabasca. It was found on moist to wet organic soils in depressional areas and along lakeshores. Tree cover was generally less than 5% cover consisting of stunted *Picea mariana* (≤ 2 m tall) with occasional *Larix laricina* trees. *Ledum groenlandicum* dominated the shrub layer and was co-dominant with *Chamaedaphne calyculata*. Important species in the herb layer included *Rubus chamaemorus*, sedges. Moss cover was high and consisted mainly of *Sphagnum fuscum* and *S. magellanicum*.

Alberta Energy and Natural Resources (1978a, 1978b) identified a treed bog type for the Wapiti – Grande Prairie sand dunes as *Picea mariana - Larix laricina / Ledum groenlandicum- Salix* spp. / *Sphagnum* sp. This interdune community occurred on depressional to level sites with generally poorly drained organic soils.

Beckingham and Archibald (1996) identify a *Picea mariana - Larix laricina / Betula pumila / Carex* spp. / *Sphagnum* spp. shrub type (j2.1) in the boreal mixedwood. Site conditions appeared similar to the site completed at North Buck Lake. The j2.1 type had very similar plant species composition with the exception that the current plot did not support *Larix laricina, Betula pumila, Salix* spp., *Rubus chamaemorus, Carex* spp. or *Tomentypnum nitens*. Beckingham and Archibald (1996) identify a second shrubby bog type as *Picea mariana - Larix laricina / Betula pumila / Carex* spp. / *Sphagnum* spp. (i2.1). This was a boreal mixedwood community that occurred on similar sites. Species composition was very similar, however, *Chamaedaphne calyculata, Rubus chamaemorus, Pleurozium schreberi,* and *Polytrichum strictum* did not occur in the North Buck Lake plot.

NatureServe (2004) identified a *Picea mariana - (Larix laricina) / Ledum groenlandicum / Sphagnum* spp. Forest (CEGL005271) found in boreal regions of central and eastern Canada and adjacent areas in the United States. Sites were poorly drained with thick peat layers and low nutrient levels. The canopy was generally closed *Picea mariana* with some cover of *Abies balsamea, Larix laricina*, and *Pinus banksiana* (Sims *et al.* 1989). Shrub layer cover was moderately high consisting of *Chamaedaphne calyculata, Gaultheria hispidula, Kalmia polifolia, Ledum groenlandicum*, and *Vaccinium myrtilloides*, and *Cornus canadensis*. The herbaceous layer was thin consisting of *Carex trisperma, Eriophorum vaginatum var. spissum, Clintonia borealis*, and *Maianthemum trifolium (= Smilacina trifolia)*. The moss layer was dense and consisted of *Sphagnum* spp., *Dicranum polysetum*, and *Pleurozium schreberi*.

NatureServe (2004) lists a *Picea mariana / Ledum groenlandicum / Carex trisperma / Sphagnum* spp. Forest (CEGL002485) ranked G5. It was a raised bog community found in the sub-boreal to boreal regions of Quebec to Manitoba (Sims *et al.* 1989) in Canada and adjacent areas of the United States. Stands were typically in large peatland complexes on sites that were poorly drained Organic soils. *Picea mariana* cover was commonly at least 25% canopy and scattered *Larix laricina* may be present. *Ledum groenlandicum* cover was high and other common shrubs include *Chamaedaphne calyculata, Vaccinium myrtilloides, Vaccinium oxycoccos, Kalmia polifolia, Kalmia angustifolia, Gaultheria hispidula*, and *Andromeda polifolia*. The herb/graminoid was may contain *Carex trisperma, Eriophorum vaginatum*, and

Maianthemum trifolium. Moss cover was high and consisted of *Sphagnum magellanicum*, *Sphagnum fuscum*, *Sphagnum recurvum*, and *Sphagnum angustifolium*, and some *Sphagnum capillifolium (= Sphagnum nemoreum)* and *Sphagnum girgensohnii*. Patches of *Pleurozium schreberi* or other feather moss may be present.

NatureServe (2004) lists a *Picea mariana / Ledum groenlandicum / Sphagnum* spp. Dwarf-shrubland (CEGL002525) that was ranked GNR. This type was based on a concept developed by the Manitoba CDC classification (Greenall 1996). It occurred in Manitoba and Ontario.

A muskeg type that was widespread through the sub-boreal regions of Canada was the *Picea mariana / Chamaedaphne calyculata / Sphagnum* spp. Dwarf-shrubland (CEGL005218) (NatureServe 2004). This peatland type was found mainly on the crests of raised bogs and in basin bogs. Stands consist of stunted *Picea mariana* and *Larix laricina*. Dominant low shrub species include *Andromeda polifolia var. glaucophylla*, *Chamaedaphne calyculata*, *Kalmia polifolia*, *Ledum groenlandicum*, *Gaultheria hispidula* and *Vaccinium oxycoccos*. The herbaceous layer included *Carex oligosperma*, *Carex pauciflora*, *Eriophorum vaginatum*, *Maianthemum stellatum* and *Sarracenia purpurea*. *Sphagnum* spp. including *Sphagnum fuscum* and *Sphagnum magellanicum* formed continuous mats often with patches of *Pleurozium schreberi*. Similarity ratings for related plant community types are provided in Table 49.

Table 49. Correlation table of plant community types with similarity ratings for the *Picea mariana / Ledum groenlandicum / Sphagnum fuscum* type.

Similar Types	Similarity Rating	Comments
Picea mariana - Larix laricina / Ledum groenlandicum /Sphagnum sp. CT (Hermesh 1972)	2	Appears to be the same type but no details available regarding percent cover or associated species.
Picea mariana / Ledum groenlandicum / Sphagnum fuscum Woodland/Forest (Allen *et al.* 2003)	1(2)	No details were available for this review but this CT was considered to be widespread in the region.
Picea mariana / Chamaedaphne calyculata – Kalmia polifolia / Sphagnum spp. CT (Allen and Johnson no date.)	3	Possibly a similar community type but no details were available regarding the height of the *Picea mariana*, species composition, or percent ground cover of dominants.
Picea mariana – Larix laricina / Ledum groenlandicum- Salix spp. / *Sphagnum* sp. CT (Alberta Energy and Natural Resources 1978a, 1978b)	2 (1)	Limited details were provided on this community but it appears to be the same type as the current classification.
Picea mariana – Larix laricina / Betula pumila / Carex spp. / *Sphagnum* spp. CT (j2.1) (Beckingham and Archibald 1996)	2(3)	Very similar type although there were several important differences in dominant or diagnostic species.
Picea mariana – Larix laricina / Betula pumila / Carex spp. / *Sphagnum* spp. CT (i2.1) (Beckingham and Archibald 1996)	2(1)	Minor differences in plant composition attributed to small sample site on current study and slight differences in site moisture regime.
Picea mariana / Ledum groenlandicum / Sphagnum spp. Dwarf-shrubland (CEGL002525) (NatureServe 2004)	1(2)	Limited data available for review but this appears to be the same type.

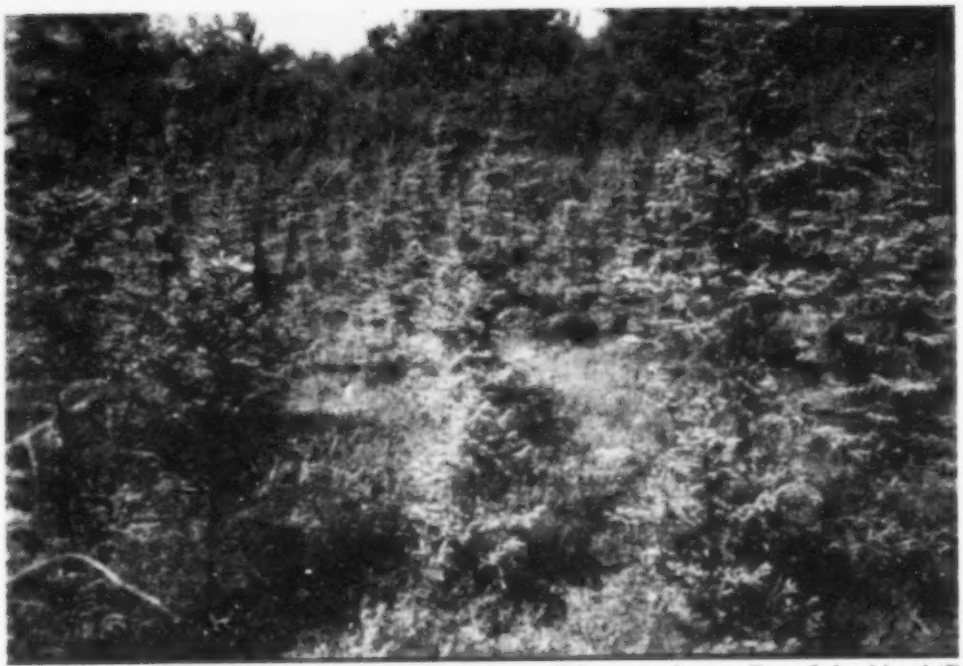


Plate 24. *Picea mariana / Ledum groenlandicum / Sphagnum fuscum* Dwarf-shrubland (P58).

3.3.3 Herbaceous Vegetation

3.3.3.1 *Carex diandra* Wet Meadow Herbaceous Vegetation
Two-stamen Sedge Wet Meadow Herbaceous Vegetation

This sedge fen community was found in wet depressions between transverse dunes. One sample was completed in the Holmes Crossing Sandhills Ecological Reserve (Table 50). It was not observed in North Buck Lake although it was expected to occur there also. Sites were very poorly drained with subhydric moisture levels and the thick Organic soils had a permesotrophic nutrient regime. Surface substrates were organic matter (80%) with standing water (20%) and a trace of decaying wood. Species diversity was low and *Carex diandra* was the dominant species. Associated species included *Polygonum amphibium, Potentilla norvegica,* and *Carex chordorrhiza*. Plot 24 also supported *Carex diandra* yet was a wetter site that was dominated by *Carex utriculata*.

Class: Herbaceous Vegetation
Subclass: Perennial graminoid vegetation
Group: Temperate or subpolar grassland
Subgroup: Natural/Semi-natural temperate or subpolar grassland
Formation: Seasonally flooded temperate or subpolar grassland
Alliance: *Carex* spp. Seasonally Flooded Herbaceous Alliance
Association: *Carex diandra* Wet Meadow Herbaceous Vegetation
Unique Identifier: NatureServe CEGL002549
Classification Confidence Level: 3 (Weak) Only one plot completed in this type and it was not well defined in the literature. A similar type was known to occur in Manitoba.

Dominant Species: *Carex diandra*
Co-Dominant Species: *Polygonum amphibium, Potentilla norvegica, Carex chordorrhiza*
Diagnostic Species: *Carex diandra*

Table 50. Summary of plot data and descriptive statistics for the *Carex diandra* community type (n=1).

			Plots
Strata	Code	Species	P12
G	CAREDIA	*Carex diandra*	11.0
H	POLYAMP	*Polygonum amphibium*	4.0
G	CARECHO	*Carex chordorrhiza*	4.0
H	POTENOR	*Potentilla norvegica*	2.0
M	MOSSES$$	*Unidentified Moss* spp.	2.0
G	AGROSCA	*Agrostis scabra*	0.1

Literature Review:

Beckingham and Archibald (1996) identified a *Carex* spp. fen community (k3.1) in the boreal mixedwood. The species of *Carex* were not provided for this type but this would appear to be a related community. Other diagnostic species for this type included *Potentilla palustris, Menyanthes trifoliata, Brachythecium* spp. and *Drepanocladus* spp.

NatureServe (2004) lists a *Carex diandra* Wet Meadow Herbaceous Vegetation (CEGL002549) that occurred in Manitoba (Greenall 1996). *Carex diandra* was the dominant species but no further details regarding this type were provided. No other similar types were located for this review. Similarity ratings for related plant community types are provided in Table 51.

Table 51. Correlation table of plant community types with similarity ratings for *Carex diandra* type.

Similar Types	Similarity Rating	Comments
Carex diandra Wet Meadow Herbaceous Vegetation CEGL002549 (NatureServe 2004)	2	*Carex diandra* was the dominant species and this type was reported to occur in Manitoba. No other data provided to further confirm similarity of type.
Carex spp. fen CT (k3.1) (Beckingham and Archibald 1996)	3(2)	Species of *Carex* was not provided but was a similar community.

3.3.3.2 *Carex utriculata* Herbaceous Vegetation
Small Bottle Sedge Herbaceous Vegetation

This wetland community occurred in interdune depression sites where the water table remains at or near ground level throughout the year. It was not encountered in the North Buck Lake study area and only one site was sampled in the Holmes Crossing Sandhills Ecological Reserve (Table 52). At this site there was approximately 15 cm of standing water present at the date of sampling. Soils consisted of a thick layer of Organic materials that were very poorly drained resulting in hydric moisture levels and a mesotrophic nutrient regime. Surface substrates were mainly water (70%), organic materials (30%), and a trace of decaying wood. Species diversity was low and the dominant species was *Carex utriculata*, which was the diagnostic species that defines the community. Other typical species included Carex *diandra* and *Equisetum fluviatile.*

Class: Herbaceous Vegetation
Subclass: Perennial graminoid vegetation
Group: Temperate or subpolar grassland
Subgroup: Natural/Semi-natural temperate or subpolar grassland
Formation: Seasonally flooded temperate or subpolar grassland
Alliance: *Carex (rostrata, utriculata)* Seasonally Flooded Herbaceous Alliance
Association: *Carex utriculata* Herbaceous Vegetation
Unique Identifier: n/a
Classification Confidence Level: 3 (Weak) Only one plot was completed in this type and there was considerable variation in community types reviewed in the literature. Geographical distribution was uncertain.

Dominant Species: *Carex utriculata*
Co-Dominant Species: *Carex diandra, Equisetum fluviatile*
Diagnostic Species: *Carex utriculata*

Table 52. Summary of plot data and descriptive statistics for the *Carex utriculata* community type (n=1).

Strata	Code	Species	Plot P24
G	CAREUTR	*Carex utriculata*	15.0
G	CAREDIA	*Carex diandra*	7.0
H	EQUIFLU	*Equisetum fluviatile*	0.5

Literature Review:

Timoney and Robinson (1998) identified one related type in the Ft. Assiniboine Sandhills Wildland Park. This community was described as a *Carex lasiocarpa - C. utriculata - C. chordorhiza / Drepanocladus revolvens* type.

Allen *et al.* (2002) observed a *Carex utriculata – C. atherodes* community that occurred in the La Butte Creek Wildland Provincial Park located north of Lake Athabasca. This was a narrow wet meadow that included patches of *Equisetum fluviatile,* and some *C. aquatilis* and *Potentilla palustris.* Allen *et al.* (2003) noted that the *Carex utriculata* type was present but not common in the Fidler-Greywillow Wildland Provincial Park at Lake Athabasca. Here it was found at the edge of a wetland behind shoreline dunes. Allen and Johnson (no date.) described a *Carex utriculata* community type from the Richardson River Dunes Wildland Park. Here it was found in a small bowl wetland located in the centre of parabolic dune. Meijer (2002b) also identified a *Salix pedicellaris - Carex utriculata* community for the Richardson River Dunes Wildland Park. *Salix pedicellaris* and *Carex utriculata* cover was 4% and 25%, respectively. Other wetland species included *Equisetum fluviatile, Potentilla palustris,* and *Petasites sagittatus.*

Beckingham and Archibald (1996) identified a *Carex* spp. fen community (k3.1) in the boreal mixedwood. The species of *Carex* were not provided for this type but this would appear to be a related community. Other diagnostic species for this type include *Potentilla palustris, Menyanthes trifoliata, Brachythecium* spp. and *Drepanocladus* spp.

This community type shares similarities with several other wetland types and may intergrade into *Carex aquatilis* communities or the *Carex diandra* Community Type. Thompson and Hansen (2002) indicated that it was a widespread type and analysed 50 stands from southern Alberta and the United States. In the United States it occurred in Sierra Nevada meadows in California, riparian areas in Montana, Idaho and Utah, and wetlands in Yellowstone National Park, Wyoming. This was a very wet community type that occurred adjacent to low gradient streams in wide valley bottoms, beaver ponds, or near perennial seeps. Standing water was common but sites may become relatively dry later in the season (Thompson and Hansen 2002). Soils were typically Organic and water tables remain at or above the ground surface throughout the growing season. In comparison to *Carex aquatilis* stands soils in the *Carex utriculata* community type were more anaerobic.

NatureServe (2004) describes a *Carex utriculata* community type (CEGL001562) that occurred throughout much of the western United States. Typically it occurred in montane and subalpine areas adjacent to lakes, beaver ponds, slow-moving streams, marshy areas, and overflow channels on broad floodplains. Soils were variable but the water table stays near the soil surface for the majority of the growing season. Graminoids were the dominant vegetation although there may be a few scattered willows. *Carex utriculata* cover dominates these stands (20% to 99% cover) with less cover of other graminoids such as *Carex lenticularis, Carex aquatilis*, and *Carex microptera, Calamagrostis canadensis, Glyceria striata*, and *Juncus balticus*. The forb layer was sparse but usually included *Geum macrophyllum, Mentha arvensis*, and *Mimulus guttatus*. A second similar type listed by NatureServe (2004) was the *Carex* *aquatilis – Carex utriculata* Herbaceous Vegetation (CEGL001803). In this type *Carex aquatilis* and *Carex utriculata* had approximately equal cover values.

Based on the dominance of *Carex utriculata* in the communities described above they were considered to be essentially the same type as the current classification. The main differences were the presence of *Carex diandra* in the boreal sand dunes plot and the absence of wetlands species common to southern Alberta and the United States. Similarity ratings for related plant community types are provided in Table 53.

Table 53. Correlation table of plant community types with similarity ratings for the *Carex utriculata* type.

Similar Types	Similarity Rating	Comments
Carex utriculata / Moss spp. CT (Nelson *et al.* 1989)	1	Same community type based on very similar site characteristics and floristics.
Carex lasiocarpa - C. utriculata - C. chordorhiza / Drepanocladus revolvens CT (Timoney and Robinson 1998)	3	This was likely a related type but there appears to be significant differences based on dominant species listed for the type. No details regarding floristics of the stand were available for direct comparison.
Carex utriculata – C. atherodes CT (Allen *et al.* 2002)	3	Likely a similar type but no *Carex atherodes* was noted in the current community type.
Carex utriculata CT (Allen *et al.* 2003)	1(2)	Based on limited information available this was considered to be the same type.
Carex utriculata CT (Allen and Johnson no date)	1(2)	No details were provided but was expected to be the same type
Salix pedicellaris - Carex utriculata CT (Meijer 2002b)	3(2)	Species composition and percent cover was different but This was considered a related *Carex utriculata* type.
Carex spp. fen CT (k3.1) (Beckingham and Archibald 1996)	3(2)	Species of *Carex* was not provided but was a similar community.
Carex utriculata CT (Thompson and Hansen 2002)	2	Shares same diagnostic species and site characteristics but no Carex diandra indicated and much reduced species diversity.
Carex utriculata CT (CEGL001562) (NatureServe 2004)	2	Same type but there was some variance in floristics attributed to differences in species ranges for the two types.
Carex aquatilis - Carex utriculata Herbaceous Vegetation (CEGL001803) (NatureServe 2004)	3	This type was confined to mountain habitats and has significant cover of *Carex aquatilis* in contrast to the current classification. Also *Carex diandra* was not included as an important species.

Plate 25. *Carex diandra* Wet Meadow Herbaceous Vegetation (P12).

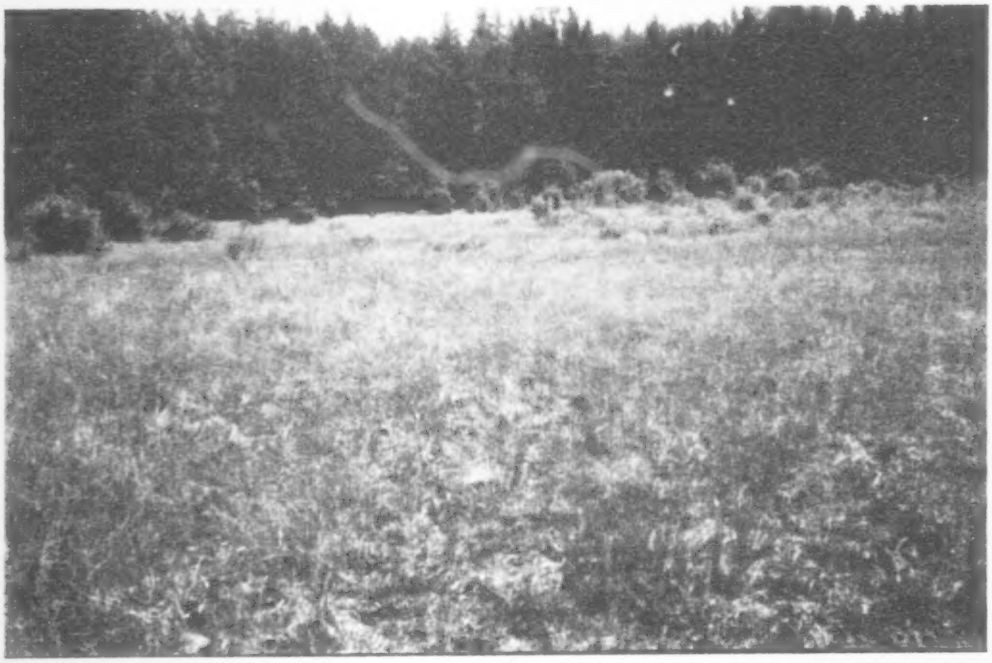


Plate 26. *Carex utriculata* Herbaceous Vegetation (P24).

3.3.3.3 *Calamagrostis canadensis - Potentilla palustris* Herbaceous Vegetation

Bluejoint – Marsh Cinquefoil Herbaceous Vegetation

This community type appears to be common in both study areas. It occurred in interdune depressions often forming a distinctive band of vegetation around the perimeter of sedge fens and an intergrade to upland sites. Three sites were sampled including one in Holmes Crossing Sandhills Ecological Reserve and two in North Buck Lake study area (Table 54). *Calamagrostis canadensis* content was typically high with a mean ground cover of 60% and ranging between 50% and 70%. Diagnostic species for this community type were *Calamagrostis canadensis* and *Potentilla palustris*. Other species were variable and may include *Petasites* spp., *Sphagnum* spp., *Salix bebbiana, Salix pedicellaris, Salix pyrifolia, Polygonum amphibium, Carex* spp., *Equisetum fluviatile, Caltha palustris, Drepanocladus aduncus* and other wetland species. Sites may be subjected to periodic or frequent flooding and seasonal drawdown. A thick layer of Organic soils were typical and these were imperfectly to very poorly drained. Moisture regimes were hydric to subhygric soil nutrient regimes were mesotrophic to permesotrophic. Standing water was common at sites at the plots sampled and averaged 11% of the ground surface area with organic matter accounting for the remaining 89%.

Class: Herbaceous Vegetation
Subclass: Perennial graminoid vegetation
Group: Temperate or subpolar grassland
Subgroup: Natural/Semi-natural temperate or subpolar grassland
Formation: Saturated temperate or subpolar grassland
Alliance: *Calamagrostis canadensis* Seasonally Flooded Herbaceous Alliance
Association: *Calamagrostis canadensis - Potentilla palustris* Herbaceous Vegetation
Unique Identifier: n/a
Classification Confidence Level: 2 (Moderate) This community type forms a inter-grade between upland sites and permanently flooded lowland areas. It appears to be relatively common in both study areas and a similar type has been recorded in the Birch Mountains of northern Alberta.

Dominant Species: *Calamagrostis canadensis*
Co-Dominant Species: *Potentilla palustris, Petasites frigidus var sagittatus, Sphagnum magellanicum*
Diagnostic Species: *Calamagrostis canadensis, Potentilla palustris*

Literature Review:

Allen and Johnson (no date.) described a *Alnus tenuifolia / Calamagrostis canadensis* from the Marguerite Crag and Tail Wildland Park. No details regarding plant species composition were provided other than it was a wetland between sand deposits and Marguerite River. Unpublished plot data (pers. comm. Keith Ainsley 2005) from the Birch Mountains of northern Alberta indicate a similar community type occurred there (see plots BM: 48, 64, 77). *Calamagrostis canadensis* was the dominant cover and averaged 73% at the sites sampled. Species diversity was low but there was good correlation between species recorded for this type and the current classification.

Beckingham and Archibald (1996) identified a *Calamagrostis canadensis* fen type (k.3.2) based on two plots. This was a boreal mixedwood type that was very similar to the current classification. The dominant cover in both types was *Calamagrostis canadensis* and *Carex* spp. *Calamagrostis inexpansa* and *Polygonum coccineum* were also important to this type but were not recorded in the current classification.

NatureServe (2004) lists a *Calamagrostis canadensis* Western Herbaceous Vegetation (CEGL001559) that occurred widely throughout mountainous regions of western United States and Canada. It was most common in valley bottom riparian zones where flooding occurred in the spring and the water table stays within 50 cm to 80 cm of the ground surface throughout the growing season. *Calamagrostis canadensis*

Table 54. Summary of plot data and descriptive statistics for the *Calamagrostis canadensis* - *Potentilla palustris* community type (n=3).

			Plots						
Strata	Code	Species	P25	P48	P61	Mean	SE	Constancy	Prominence
G	CALACAN	*Calamagrostis canadensis*	50.0	60.0	70.0	60.0	5.8	100.0	77.5
H	POTEPAL	*Potentilla palustris*	0.0	15.0	7.0	7.3	4.3	66.7	22.1
H	PETASAG	*Petasites frigidus var sagittatus*	19.0	0.0	0.0	6.3	6.3	33.3	14.5
M	SPHAMAG	*Sphagnum magellanicum*	0.0	15.0	0.0	5.0	5.0	33.3	12.9
S3	SALIBEB	*Salix bebbiana*	0.0	10.0	0.0	3.3	3.3	33.3	10.5
S3	SALIPED	*Salix pedicellaris*	0.0	10.0	0.0	3.3	3.3	33.3	10.5
H	POLYAMP	*Polygonum amphibium*	0.0	0.0	9.0	3.0	3.0	33.3	10.0
G	CARELAS	*Carex lasiocarpa*	0.0	7.0	0.0	2.3	2.3	33.3	8.8
H	EQUIFLU	*Equisetum fluviatile*	4.0	0.0	0.0	1.3	1.3	33.3	6.7
S2	SALIPYR	*Salix pyrifolia*	0.0	0.0	4.0	1.3	1.3	33.3	6.7
M	DREPADU	*Drepanocladus aduncus*	0.0	4.0	0.0	1.3	1.3	33.3	6.7
G	CARECUR	*Carex canescens*	0.0	2.0	0.0	0.7	0.7	33.3	4.7
H	CALTPAL	*Caltha palustris*	1.0	0.0	0.0	0.3	0.3	33.3	3.3
G	CAREUTR	*Carex utriculata*	0.5	0.0	0.0	0.2	0.2	33.3	2.4
G	AGROSCA	*Agrostis scabra*	0.0	0.5	0.0	0.2	0.2	33.3	2.4
H	SCUTGAL	*Scutellaria galericulata*	0.0	0.1	0.0	0.0	0.0	33.3	1.1

was the dominant cover type in association with *Carex aquatilis* and *Glyceria* spp. Trees such as *Pinus contorta*, *Abies lasiocarpa*, and *Picea engelmannii* may be present with low cover values. Shrub cover was usually 1% to 5% and may include *Alnus incana*, *Symphoricarpos* spp., and *Salix* spp. Other species may include *Carex utriculata*, *Carex nebrascensis*, *Carex canescens* and *Carex saxatilis*. Forb cover was variable (0% to 25%) and may include *Caltha leptosepala*, *Senecio triangularis*, *Heracleum maximum*, *Mentha arvensis*, *Geum macrophyllum* and *Epilobium* spp. Another similar wetland type listed by NatureServe (2004) was the *Calla palustris* - *Carex canescens* - *Calamagrostis canadensis* Fen Herbaceous Vegetation (CEGL002548). This community was part of the "*Carex* spp. Saturated Herbaceous Alliance" and was reported to occur in Manitoba. Similarity ratings for related community types are provided in Table 55.

Table 55. Correlation table of plant community types with similarity ratings for the *Calamagrostis canadensis* - *Potentilla palustris* type.

Similar Types	Similarity Rating	Comments
Alnus tenuifolia / *Calamagrostis canadensis* CT (Allen and Johnson no date)	3	Possibly a similar type but has a shrub layer dominated by *Alnus tenuifolia*.
Calamagrostis canadensis CT (pers. comm. Keith Ainsely 2005)	1	Very similar *Calamagrostis canadensis* CT that occurred on similar sites and has a similar species composition.
Calamagrostis canadensis fen CT (k.3.2) (Beckingham and Archibald 1996)	1(2)	Very similar type although no *Calamagrostis inexpansa* was recorded in the current classification.
Calamagrostis canadensis Western Herbaceous Vegetation (CEGL001559) (NatureServe 2004)	3(2)	Mountain wetland type that occurs in western United States and Canada. *Calamagrostis canadensis* was dominant but there were dissimilarities in floristics.
Calla palustris - *Carex canescens* - *Calamagrostis canadensis* Fen Herbaceous Vegetation (CEGL002548) (NatureServe 2004)	3	This appears to be a wetter type of community but no details were provided regarding floristics. It occurred in Manitoba.

3.3.3.4 *Poa palustris* Herbaceous Vegetation

Fowl Bluegrass Herbaceous Vegetation

This was a semi-natural type that was sampled in North Buck Lake study area (Table 56). One plot was completed in a narrow band of vegetation (2 m to 5 m wide) that occurred on the north shore of Big Johnson Lake (i.e. Chump Lake). This site appeared to be flooded seasonally and subjected to wash from wave action. The soils were imperfectly drained with variable moisture levels ranging from subhygric to submesic moving upslope. The nutrient regime was mesotrophic. At the plot sampled, surface substrates were mainly organic matter (77%), mineral (20%) and decaying wood (3%). This type was recognised by the dominance of *Poa palustris* and a diversity of other plant species (Table 56). Associated species in the one stand sampled included *Salix pseudomonticola, Hippuris vulgaris, Mentha arvensis, Sonchus arvensis, Juncus tenuis, Phalaris arundinacea, Crepis tectorum, Eleocharis palustris* and *Scirpus acutus*. The adjacent emergent zone was 20 m to 150 m wide and was dominated by *Scirpus acutus, Nuphar lutea, Eleocharis palustris, Sagittaria cuneata* and *Hippuris vulgaris*.

Class: Herbaceous Vegetation
Subclass: Perennial graminoid vegetation
Group: Temperate or subpolar grassland
Subgroup: Natural/Semi-natural temperate or subpolar grassland
Formation: Seasonally flooded temperate or subpolar grassland
Alliance: *Poa palustris* Semi-natural Seasonally Flooded Herbaceous Alliance
Association: *Poa palustris* Herbaceous Vegetation
Unique Identifier: A.1409 Alliance
Classification Confidence Level: 3 (Weak) *Poa palustris* was the dominant species but there was expected to be considerable variability in species composition within this plant community. Only one other similar community type was reviewed. The geographical range of this community was unknown.

Dominant Species: *Poa palustris*
Co-Dominant Species: *Salix pseudomonticola, Hippuris vulgaris, Mentha arvensis, Sonchus arvensis, Juncus tenuis*
Diagnostic Species: *Poa palustris*

Literature Review:

Allen *et al.* (2002) reported a *Poa palustris – Calamagrostis stricta* community type that occurred in the La Butte Creek Wildland Provincial Park located north of Lake Athabasca. This stand was in an extensive mesic meadow that was apparently located in an old river channel.

NatureServe (2004) lists a *Poa palustris* Semi-natural Seasonally Flooded Herbaceous Alliance (A.1409) that appears to be very similar to the current classification. It was a semi-natural grassland type that was expected to be widespread. *Poa palustris* was the dominant species and was often associated with a variety of non-native weedy species. This alliance type occurred on mesic alluvial sites that were commonly seasonally flooded. Similarity ratings for related plant community types are provided in Table 57.

Table 56. Summary of plot data and descriptive statistics for the *Poa palustris* Semi-natural Seasonally Flooded Herbaceous Alliance type (n=1).

Strata	Code	Species	Plot 33
G	POAPALU	*Poa palustris*	20.0
H	MENTARV	*Mentha arvensis*	9.0
H	SONCARV	*Sonchus arvensis*	5.0
S3	SALIPSE	*Salix pseudomonticola*	5.0
G	JUNCDUD	*Juncus tenuis*	4.0
H	HIPPVUL	*Hippuris vulgaris*	4.0
G	PHALARU	*Phalaris arundinacea*	2.0
H	CREPTEC	*Crepis tectorum*	2.0
G	ELEOPAL	*Eleocharis palustris*	2.0
G	SCIRACU	*Scirpus acutus*	2.0
S3	SALIBEB	*Salix bebbiana*	2.0
G	AGROSCA	*Agrostis scabra*	1.0
G	ALOPAEQ	*Alopecurus aequalis*	1.0
H	PARNPAL	*Parnassia parviflora*	0.5

Strata	Code	Species	Plot 33
H	GALITRI	*Galium trifidum*	0.5
S3	POPUBAL	*Populus balsamifera*	0.5
H	POLYLAP	*Polygonum lapathifolium*	0.5
S3	BETUPAP	*Betula papyrifera*	0.5
G	CAREAQU	*Carex aquatilis*	0.5
G	HORDJUB	*Hordeum jubatum*	0.5
G	SPHEINT	*Sphenopholis intermedia*	0.5
H	POTENOR	*Potentilla norvegica*	0.5
G	CARECRA	*Carex crawfordii*	0.2
G	JUNCNOD	*Juncus nevadensis*	0.1
S3	SALIPET	*Salix petiolaris*	0.1
S3	POPUTRE	*Populus tremuloides*	0.1
H	RUMEMAR	*Rumex maritimus*	0.1
H	FRAGVIR	*Fragaria virginiana*	0.1

Table 57. Correlation table of plant community types with similarity ratings for the *Poa palustris* Semi-natural Seasonally Flooded Herbaceous Alliance type.

Similar Types	Similarity Rating	Comments
Poa palustris – Calamagrostis stricta CT (Allen *et al.* 2002)	3	Possibly a related type but no details were available regarding the species composition of this community. Current type likely has considerable variability in species composition.

Plate 27. *Calamagrostis canadensis - Potentilla palustris* Herbaceous Vegetation (P48).

Plate 28. *Poa palustris* Herbaceous Vegetation (P33).

3.3.3.5 *Festuca saximontana - Artemisia campestris* Herbaceous Vegetation
Rocky Mountain Fescue – Plains Wormweed Herbaceous Vegetation

The *Festuca saximontana - Artemisia campestris* Herbaceous Vegetation type was a relatively common type in the North Buck Lake study area but was not observed in the Holmes Crossing Sandhills Ecological Reserve. Stands were small generally under approximately 200 m^2 and typically occurred on dune crests or upper slopes. Sites were predominately convex in profile with high insolation values and rapidly to well drained soils. Aspects ranged from southeast to southwest and slopes ranged between 4% and 21% gradients with a mean of 4%. The fine sandy soils had subxeric to xeric moisture levels and submesotrophic to mesotrophic nutrient regimes. Surface substrates were largely organic matter (75%) although a significant amount of exposed mineral soil (25%) was also typical. Shrub cover was very sparse but included *Amelanchier alnifolia, Apocynum androsaemifolium,* and *Arctostaphylos uva-ursi* (Table 58). Dominant cover in this plant community consisted of *Artemisia campestris* (10%), *Carex siccata* (7%), *Cladina mitis* (8%), *Cladonia* spp. (5%), and *Polytrichum piliferum* (5%). Other important graminoid species included *Carex umbellata, Festuca saximontana, Agrostis scabra, Elymus trachycaulus, Danthonia spicata. Selaginella densa* occurred at between trace and 2% cover.

Class: Herbaceous Vegetation
Subclass: Perennial graminoid vegetation
Group: Temperate or subpolar grassland
Subgroup: Natural/Semi-natural temperate or subpolar grassland
Formation: Medium-tall bunch temperate or subpolar grassland
Alliance: *Festuca saximontana* Herbaceous Alliance
Association: *Festuca saximontana - Artemisia campestris* Herbaceous Vegetation
Unique Identifier: n/a
Classification Confidence Level: 2 (Moderate) An easily recognisable type and six plots completed in this type. It was common in the North Buck Lake study area but no identical types were located in the literature. Geographical range was unknown.

Dominant Species: *Artemisia campestris, Festuca saximontana, Cladina mitis, Cladonia* spp., *Polytrichum piliferum*
Co-Dominant Species: *Selaginella densa, Agrostis scabra, Elymus trachycaulus, Carex siccata, Carex umbellata, Danthonia spicata*
Diagnostic Species: *Artemisia campestris, Carex siccata, Carex umbellata, Festuca saximontana, Cladina mitis, Polytrichum piliferum*

Literature Review:

Allen and Johnson (no date.) described a *Carex siccata* Graminoid Slope (CT 7) from Maybelle River Wildland Park. This was a common early successional plant community that was typically occupied southeast to southwest facing mid-slope positions. Slopes were moderately steep (e.g. 20°) and soils were rapidly drained with xeric moisture levels. This community had essentially the same species composition as the current classification. However, this type had greater cover of *Carex siccata* and less cover of *Festuca saximontana* and *Artemisia campestris*. Allen and Johnson (no date.) described a *Rosa acicularis / Festuca saximontana / Arctostaphylos uva-ursi* community type that occurred in the Richardson River Dunes Wildland Park. No details were provided regarding this type other than it occurred as small shrubby openings. Raup and Argus (1982) gave a general description of a plant community that occurred on border ridges of parabolic sand dunes in the Lake Athabasca area. These occurred as small patches of sparse vegetation within *Pinus banksiana* forest or woodland openings. Typically there was a continuous mat of *Polytrichum* spp., a high percent cover of open sand, and significant cover of *Hudsonia tomentosa.*

Table 58. Summary of plot data and descriptive statistics for the *Festuca saximontana - Artemisia campestris* community type (n=6).

			Plots									
Strata	**Code**	**Species**	**P39**	**P45**	**P47**	**P53**	**P56**	**P62**	**Mean**	**SE**	**Constancy**	**Prominence**
G	FESTSAX	*Festuca saximontana*	10.0	16.0	4.0	17.0	10.0	5.0	10.3	2.2	100.0	32.1
L	CLADMIT	*Cladina mitis*	2.0	7.0	20.0	2.0	10.0	7.0	8.0	2.7	100.0	28.3
H	ARTECAM	*Artemisia campestris*	3.0	10.0	5.0	0.5	10.0	15.0	7.3	2.2	100.0	26.9
L	CLADONI	*Cladonia* spp.	5.0	2.0	0.0	0.5	0.0	25.0	5.4	4.0	66.7	19.0
M	POLYPIL	*Polytrichum piliferum*	0.0	6.0	0.0	1.0	1.0	20.0	4.7	3.2	66.7	17.6
G	CARESIC	*Carex siccata*	8.0	0.1	0.1	1.0	2.0	2.0	2.2	1.2	100.0	14.8
G	AGROSCA	*Agrostis scabra*	0.0	1.0	0.0	0.1	4.0	0.1	0.9	0.6	66.7	7.6
G	CAREUMB	*Carex umbellata*	0.5	0.5	0.5	0.0	1.0	0.5	0.5	0.1	83.3	6.5
G	DANTSPI	*Danthonia spicata*	3.0	4.0	0.0	0.0	0.0	0.0	1.2	0.7	33.3	6.2
G	ELYMTRA	*Elymus trachycaulus*	2.0	0.0	0.0	0.5	0.0	0.1	0.4	0.3	50.0	4.7
H	SELADEN	*Selaginella densa*	0.0	0.0	2.0	0.5	0.0	0.1	0.4	0.3	50.0	4.7
G	POAPRAT	*Poa pratensis*	6.0	0.0	0.0	0.0	0.0	0.0	1.0	1.0	16.7	4.1
L	CLADUNC	*Cladonia uncialis*	0.0	0.0	0.0	0.0	0.1	2.0	0.4	0.3	33.3	3.4
M	MOSSES$$	*Moss* spp.	0.0	0.0	0.0	0.5	1.0	0.0	0.3	0.2	33.3	2.9
H	STELLON	*Stellaria longipes*	1.0	0.5	0.0	0.0	0.0	0.0	0.3	0.2	33.3	2.9
H	CREPTEC	*Crepis tectorum*	0.5	0.0	0.1	0.0	0.0	0.1	0.1	0.1	50.0	2.4
S3	AMELALN	*Amelanchier alnifolia*	2.0	0.0	0.0	0.0	0.0	0.0	0.3	0.3	16.7	2.4
H	SOLISPA	*Solidago spathulata*	0.0	2.0	0.0	0.0	0.0	0.0	0.3	0.3	16.7	2.4
G	ORYZPUN	*Oryzopsis pungens*	0.0	0.0	0.0	0.0	2.0	0.0	0.3	0.3	16.7	2.4
H	APOCAND	*Apocynum androsaemifolium*	2.0	0.0	0.0	0.0	0.0	0.0	0.3	0.3	16.7	2.4
S3	ARCTUVA	*Arctostaphylos uva-ursi*	1.5	0.0	0.0	0.0	0.0	0.0	0.3	0.2	16.7	2.0
H	EQUILAE	*Equisetum laevigatum*	0.0	0.0	0.1	0.5	0.0	0.0	0.1	0.1	33.3	1.8
H	ARABDIV	*Arabis divaricarpa*	0.0	0.0	0.0	0.0	0.5	0.0	0.1	0.1	16.7	1.2
L	PELTIGE	*Peltigera* sp.	0.0	0.5	0.0	0.0	0.0	0.0	0.1	0.1	16.7	1.2
G	POAINTE	*Poa interior*	0.0	0.0	0.0	0.0	0.5	0.0	0.1	0.1	16.7	1.2
L	CLADBEL	*Cladonia bellidiflora*	0.0	0.0	0.0	0.1	0.0	0.1	0.0	0.0	33.3	1.1
H	ARABLYR	*Arabis lyrata*	0.0	0.0	0.0	0.1	0.0	0.0	0.0	0.0	16.7	0.5

Associate plant species included *Festuca saximontana, Salix bebbiana, Betula papyrifera, Prunus pensylvanica,* and *Arctostaphylos uva-ursi.* Similarity ratings for related plant community types are provided in Table 59.

Table 59. Correlation table of plant community types with similarity ratings for the *Festuca saximontana - Artemisia campestris* type.

Similar Types	**Similarity Rating**	**Comments**
Rosa acicularis / Festuca saximontana / Arctostaphylos uva-ursi CT (Allen and Johnson no date)	3(2)	This may be a similar type although no further details were provided regarding species composition and percent cover values.
Carex siccata CT (Allen and Johnson no date.)	2	A very similar community type however cover values of the dominant species was considerably different.
Polytrichum spp. - *Hudsonia tomentosa* Sparse Vegetation Type (Raup and Argus 1982)	3	Type has similar ecological site characteristics and has some plant species in common. However it inhabits active sand dunes and there were significant differences in dominant plant species composition.

3.3.3.6 *Carex siccata - Danthonia spicata* Herbaceous Vegetation

Hay Sedge - Poverty Oat Grass Herbaceous Vegetation

The *Carex siccata - Danthonia spicata* Herbaceous Vegetation type occurred as small stands under approximately 200 m^2. It was a relatively common and distinctive type in the North Buck Lake study area but not in the Holmes Crossing Sandhills Ecological Reserve. Four plots were completed in this type and these typically occurred on convex to straight sites in upper slope or occasionally mid-slope positions. Slope gradients averaging 11 % and ranged between 7% and 21%. Vegetation on these sites may be affected by insolation, although aspects were variable with two of the four plots facing southeast, one facing east and one southwest. Soils were rapidly to well drained with predominately subxeric moisture levels and mesotrophic to submesotrophic nutrient regimes. Surface substrate cover was mostly organic (92%), although there was often significant cover of exposed mineral soil (8%) and traces of decaying wood. This community was identified by the dominance and constant presence of *Carex siccata, Danthonia spicata,* and *Cladina mitis* (Table 60). This was a relatively diverse community and other important plant and lichen species included *Artemisia campestris, Stellaria longipes, Elymus trachycaulus, Festuca saximontana,* and *Cladonia* spp. The shrub layer was sparse but included scattered cover of *Apocynum androsaemifolium, Arctostaphylos uva-ursi, Prunus pensylvanica,* and *Populus tremuloides.*

Class: Herbaceous Vegetation
Subclass: Perennial graminoid vegetation
Group: Temperate or subpolar grassland
Subgroup: Natural/Semi-natural temperate or subpolar grassland
Formation: Short sod temperate or subpolar grassland
Alliance: *Carex siccata* Herbaceous Alliance
Association: *Carex siccata - Danthonia spicata* Herbaceous Vegetation
Unique Identifier: n/a
Classification Confidence Level: 2 (Moderate) An easily recognisable community and 4 plots were completed for the type. It appears to be relatively common in the North Buck Lake study area but its geographical range was unknown.

Dominant Species: *Carex siccata, Danthonia spicata, Cladina mitis*
Co-Dominant Species: *Artemisia campestris, Stellaria longipes, Elymus trachycaulus, Festuca saximontana, Cladonia* spp.
Diagnostic Species: *Carex siccata, Danthonia spicata, Festuca saximontana*

Literature Review:

Allen et al. (2004) identified a *Carex siccata* graminoid slope type that occurred in the Colin-Cornwall Lakes Wildland Provincial Park in northeastern Alberta. This community was often interspersed with patches of juniper and deciduous woodlands. It typically developed on steep south to southwest-facing slopes of sandy and gravely glacial deposits. The current type also was located on sandy soils, however, typically they occurred on more gentle slopes. This community and the current classification have a relatively good correlation of species, although this community does not include any presence of *Danthonia spicata.*

NatureServe (2004) lists a *Schizachyrium scoparium - Danthonia spicata - Carex pensylvanica - (Viola pedata)* Herbaceous Vegetation (CEGL002318). This community type was widespread throughout extending from Indiana, Michigan and southern Ontario, west to Iowa and east-central Minnesota. It was a dry sand prairie community that occurred on steep slopes, sandy outwash, sandy lake plains, and alluvial deposits. Sometimes it was found on sand ridges, sand dunes and sandy areas of coarse-textured end moraines. The herb/graminoid was dominated by graminoids including *Carex pensylvanica, Danthonia*

Table 60. Summary of plot data and descriptive statistics for the *Carex siccata-Danthonia spicata* community type (n=4).

			Plots							
Strata	**Code**	**Species**	**P38**	**P44**	**P49**	**P63**	**Mean**	**SE**	**Constancy**	**Prominence**
G	CARESIC	*Carex siccata*	10.0	3.0	40.0	15.0	17.0	8.1	100.0	41.2
L	CLADMIT	*Cladina mitis*	0.0	50.0	20.0	10.0	20.0	10.8	75.0	38.7
G	DANTSPI	*Danthonia spicata*	1.0	6.0	6.0	30.0	10.8	6.5	100.0	32.8
H	ARTECAM	*Artemisia campestris*	0.0	0.5	4.0	5.0	2.4	1.2	75.0	13.3
H	STELLON	*Stellaria longipes*	1.0	0.5	3.0	0.5	1.3	0.6	100.0	11.2
G	FESTSAX	*Festuca saximontana*	0.5	2.0	2.0	0.5	1.3	0.4	100.0	11.2
G	ELYMTRA	*Elymus trachycaulus*	2.0	0.0	5.0	0.0	1.8	1.2	50.0	9.4
L	CLADONI	*Cladonia* spp.	0.0	0.0	4.0	2.0	1.5	1.0	50.0	8.7
L	CLADUNC	*Cladonia uncialis*	0.0	0.5	0.5	2.0	0.8	0.4	75.0	7.5
H	APOCAND	*Apocynum androsaemifolium*	5.0	0.0	0.0	0.0	1.3	1.3	25.0	5.6
L	CLADGRA	*Cladonia gracilis*	0.0	0.0	0.0	4.0	1.0	1.0	25.0	5.0
S3	PRUNPEN	*Prunus pensylvanica*	4.0	0.0	0.0	0.0	1.0	1.0	25.0	5.0
S3	ARCTUVA	*Arctostaphylos uva-ursi*	0.0	0.0	0.0	4.0	1.0	1.0	25.0	5.0
S3	AMELALN	*Amelanchier alnifolia*	4.0	0.0	0.0	0.0	1.0	1.0	25.0	5.0
S3	POPUTRE	*Populus tremuloides*	0.0	0.0	0.0	2.0	0.5	0.5	25.0	3.5
L	PELTMAL	*Peltigera malacea*	0.0	0.0	0.0	2.0	0.5	0.5	25.0	3.5
M	POLYPIL	*Polytrichum piliferum*	0.0	0.1	0.0	0.5	0.2	0.1	50.0	2.7
H	CREPTEC	*Crepis tectorum*	0.1	0.0	0.1	0.1	0.1	0.0	75.0	2.4
H	VIOLADU	*Viola adunca*	0.5	0.0	0.0	0.0	0.1	0.1	25.0	1.8
H	ASTELAE	*Aster laevis*	0.0	0.0	0.0	0.5	0.1	0.1	25.0	1.8
G	POAPRAT	*Poa pratensis*	0.0	0.5	0.0	0.0	0.1	0.1	25.0	1.8
G	POAINTE	*Poa interior*	0.0	0.5	0.0	0.0	0.1	0.1	25.0	1.8
L	PELTIGE	*Peltigera* sp.	0.0	0.5	0.0	0.0	0.1	0.1	25.0	1.8
S3	ROSAACI	*Rosa acicularis*	0.0	0.0	0.0	0.5	0.1	0.1	25.0	1.8
H	EQUILAE	*Equisetum laevigatum*	0.0	0.0	0.5	0.0	0.1	0.1	25.0	1.8
H	SOLISPA	*Solidago spathulata*	0.0	0.5	0.0	0.0	0.1	0.1	25.0	1.8
H	EQUIARV	*Equisetum arvense*	0.0	0.0	0.0	0.5	0.1	0.1	25.0	1.8
M	MOSSESSS	*Moss* spp.	0.0	0.0	0.0	0.1	0.0	0.0	25.0	0.8
S2	POPUTRE	*Populus tremuloides*	0.1	0.0	0.0	0.0	0.0	0.0	25.0	0.8
G	AGROSCA	*Agrostis scabra*	0.0	0.1	0.0	0.0	0.0	0.0	25.0	0.8
H	HUDSTOM	*Hudsonia tomentosa*	0.0	0.1	0.0	0.0	0.0	0.0	25.0	0.8
L	CLADBEL	*Cladonia bellidiflora*	0.0	0.0	0.0	0.1	0.0	0.0	25.0	0.8

spicata, Koeleria macrantha, Schizachyrium scoparium, and *Hesperostipa spartea (= Stipa spartea)*. Other graminoids include *Bouteloua hirsuta, Digitaria cognata (= Leptoloma cognatum), Dichanthelium acuminatum var. fasciculatum (= Dichanthelium lanuginosum)* and sometimes *Calamovilfa longifolia*. Common forbs include *Asclepias verticillata, Ambrosia psilostachya, Artemisia frigida, Pseudognaphalium obtusifolium (= Gnaphalium obtusifolium), Euphorbia corollata, Hieracium longipilum, Lechea tenuifolia, Liatris aspera, Liatris cylindracea, Nuttallanthus canadensis (= Linaria canadensis), Lithospermum canescens, Lupinus perennis, Oenothera rhombipetala, Polygala polygama, Packera plattensis (= Senecio plattensis), Solidago nemoralis, Tephrosia virginiana* and *Viola pedata*. On blowouts and open exposed sand areas *Hudsonia tomentosa* was often present. Similarity ratings for related plant community types are provided in Table 61.

Table 61. Correlation table of plant community types with similarity ratings for the *Carex siccata-Danthonia spicata* type.

Similar Types	Similarity Rating	Comments
Carex siccata graminoid slope type (Allen et al. 2004)	2	Similar community type that occurred on steeper slopes. This type does not include *Danthonia spicata* as a dominant species.
Schizachyrium scoparium - Danthonia spicata - Carex pensylvanica - (*Viola pedata*) Herbaceous Vegetation (CEGL002318) NatureServe (2004)	3	Appears to be a distantly related type occupying a similar ecological niche but there were many differences in floristics and the known range does not extend west of Ontario.

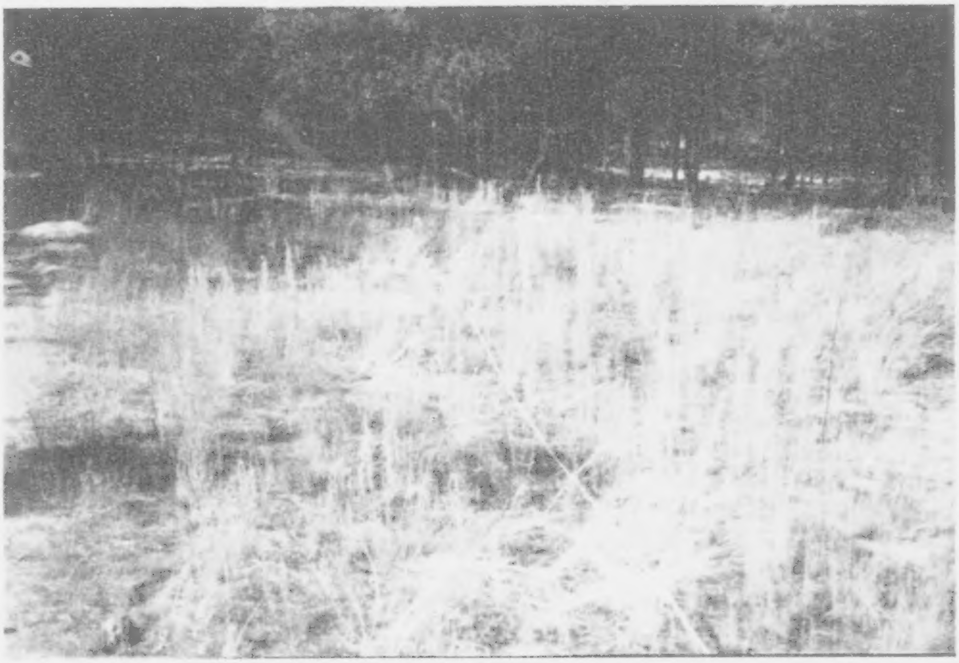


Plate 29. *Festuca saximontana - Artemisia campestris* Herbaceous Vegetation (P45).

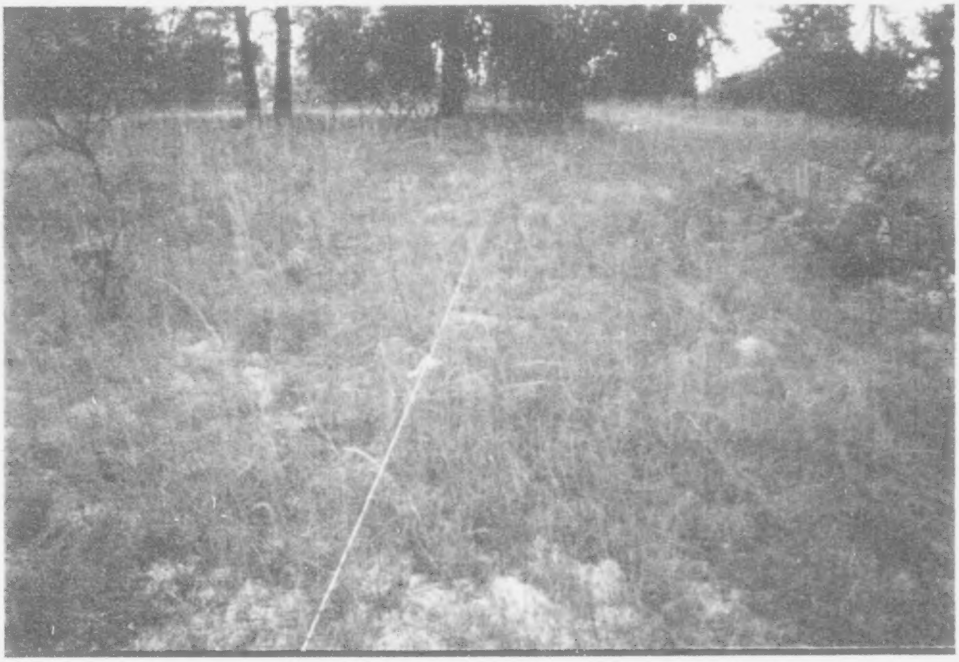


Plate 30. *Carex siccata - Danthonia spicata* Herbaceous Vegetation (P49).

3.3.3.7 *Elymus trachycaulus - Carex pensylvanica - Selaginella densa* Herbaceous Vegetation

Slender Wheat Grass - Sun-Loving Sedge - Prairie Selaginella Herbaceous Vegetation

This was not a common type and only one example of it was encountered in Holmes Crossing Sandhills Ecological Reserve (Table 62). This stand was located on a mid-slope position with a convex profile, south aspect, and slope gradient of 28%. This site was subjected to high levels of insolation and had well drained sandy soils with submesic moisture levels, and a mesotrophic nutrient regime. Surface substrate cover was largely organic matter (90%), although exposed mineral soil (10%) was also prevalent. Shrub cover was limited to small patches of *Arctostaphylos uva-ursi* (4%). Dominant cover in the herbaceous layer consisted of *Elymus trachycaulus* (30%), *Carex pensylvanica* (10%), and *Selaginella densa* (6%). Other important species may include *Anemone multifida, Aster laevis, Galium boreale, Solidago spathulata, Carex siccata, Carex umbellata,* and *Festuca saximontana.*

Class: Herbaceous Vegetation
Subclass: Perennial graminoid vegetation
Group: Temperate or subpolar grassland
Subgroup: Natural/Semi-natural temperate or subpolar grassland
Formation: Medium-tall sod temperate or subpolar grassland
Alliance: *Elymus trachycaulus* Herbaceous Alliance
Association: *Elymus trachycaulus - Carex pensylvanica - Selaginella densa* Herbaceous Vegetation
Unique Identifier: n/a
Classification Confidence Level: 3 (Weak) Only one stand was encountered and there was limited reference to similar types in the literature. Geographical range of this type was not known.

Dominant Species: *Elymus trachycaulus, Carex pensylvanica, Selaginella densa,*
Co-Dominant Species: *Arctostaphylos uva-ursi, Anemone multifida, Aster laevis, Galium boreale, Solidago spathulata, Carex siccata, Carex umbellata, Festuca saximontana*
Diagnostic Species: *Elymus trachycaulus, Carex pensylvanica, Selaginella densa*

Table 62. Summary of plot data and descriptive statistics for the *Elymus trachycaulus - Carex pensylvanica - Selaginella densa* Herbaceous Vegetation community type (n=1).

			Plot
Strata	**Code**	**Species**	**P11**
G	ELYMTRA	*Elymus trachycaulus*	30.0
G	CAREPEN	*Carex pensylvanica*	10.0
H	SELADEN	*Selaginella densa*	6.0
G	CAREUMB	*Carex umbellata*	5.0
G	CARESIC	*Carex siccata*	4.0
G	FESTSAX	*Festuca saximontana*	4.0
S3	ARCTUVA	*Arctostaphylos uva-ursi*	4.0
H	GALIBOR	*Galium boreale*	3.0
H	SOLISPA	*Solidago spathulata*	2.0
H	ASTELAE	*Aster laevis*	2.0
H	ASTRROB	*Astragalus robbinsii*	2.0
H	ANEMMUL	*Anemone multifida*	0.5
L	CLADMIT	*Cladina mitis*	0.5
H	EQUIHYE	*Equisetum hyemale*	0.5
H	ANDRSEP	*Androsace septentrionalis*	0.1
M	POLYPIL	*Polytrichum piliferum*	0.1

Literature Review:

Timoney and Robinson (1998) noted an *Elymus trachycaulus / Arctostaphylos uva-ursi* grassland type existing in Ft. Assiniboine Sandhills Wildland Park that was successional to aspen forest. It was found on subxeric grassy sand dunes. They reported that this grassland was sporadic but widespread throughout the parkland and boreal forest and was often found in association with hairy wild rye, and sometimes *Stipa* spp.

Allen (2004) lists an *Elymus trachycaulus - Koeleria macrantha* that occupies level salt plains in the Peace River Lowlands Subregion. Soils were moderately well to rapidly drained with mostly subxeric moisture regimes. *Elymus trachycaulus* and *Koeleria macrantha* were dominant plant species and other co-dominants include *Juniperus horizontalis, Hierochloe odorata, Deschampsia caespitosa, Danthonia intermedia, Schizachne purpurascens* and *Agrostis scabra*. Other plant species recorded in the Wood Buffalo National Park area included *Helictotrichon hookeri, Carex pensylvanica, Bromus inermis, Artemisia frigida, Stipa curtiseta, Muhlenbergia richardsonis, Festuca scabrella,* and *Carex obtusata.* Allen *et al.* (2002) reported an *Arctostaphylos uva-ursi - Elymus trachycaulus* Dwarf-shrubland that occurred in the La Butte Creek Wildland Provincial Park located north of Lake Athabasca. This type was found on the top of an eroded steep slope consisting of coarse sand and gravel with cobbles. Cover of *Arctostaphylos uva-ursi* was 80% and cover of *Elymus trachycaulus* was 7%. This type shared few other species in common with the current type and no *Carex pensylvanica* or *Selaginella densa* was recorded at the one plot completed in the Park. Similarity ratings for related plant community types are provided in Table 63.

Vujnovic and Bentz (2001) reported that the *Elymus trachycaulus* type was widespread throughout the province and was found in the grassland, montane, foothills and boreal regions. The authors reviewed a number of studies from various ecoregions identifying *Elymus trachycaulus* dominated communities from both within and outside the province. In reviewing these types there appears to be a larger degree of variation in the plant species composition. Types reported for the boreal forest appeared most similar but these did not include *Carex pensylvanica, Selaginella densa,* or most of the other species found in the Holmes Crossing study area plot.

Wildlands Ecological Consulting Ltd. (2004) reported an *Elymus trachycaulus* community that occurred as a small band of homogenous vegetation in a riparian zone in Writing-on-Stone Provincial Park. This stand had 50% to 75% cover of *Elymus trachycaulus.* Other species noted adjacent to this type were *Glycyrrhiza lepidota, Hordeum jubatum,* and X *agrohordeum macounii.* Soils were moderately well drained with mesic moisture levels and a mesotrophic nutrient regime.

Table 63. Correlation table of plant community types with similarity ratings for the *Elymus trachycaulus - Carex pensylvanica - Selaginella densa* type.

Similar Types	**Similarity Rating**	**Comments**
Elymus trachycaulus CT (Timoney and Robinson 1998)	1(2)	Based on the proximity of the study areas and brief description of this grassland type it appears to be the same community. No detailed floristic data was available for review.
Elymus trachycaulus – Koeleria macrantha CT (CEAB000150) (Allen 2004)	2	Considerable differences in floristics although the *Elymus trachycaulus* was a dominant and *Carex pensylvanica* appears to be an associate species.
Elymus trachycaulus CT (Vujnovic and Bentz 2001)	3	*Elymus trachycaulus* was the dominant species but there was a large variation in species composition.
Elymus trachycaulus CT (Wildlands Ecological Consulting Ltd. 2004)	3	Type was dominated by *Elymus trachycaulus* but there were important differences in species composition and in ecological site conditions.

Plate 31. *Elymus trachycaulus - Carex pensylvanica - Selaginella densa* Herbaceous Vegetation (P11).

4.0 CONCLUSION

A sampling protocol was developed to collect floristics data on plant communities of the sand dunes and sand plains occurring in the Holmes Crossing Sandhills Ecological Reserve and North Buck Lake proposed provincial park and natural area. These study areas were selected by Resource Data Branch of Alberta Sustainable Resource Development, for their eolian landforms representative of the Boreal Central Mixedwood and Dry Boreal Mixedwood Natural Subregions, respectively. In forested and shrublands communities a nested plot was used to sample tree, shrub and herbaceous vegetation. In grassland dominated communities a series of Daubenmire plots were completed along transects. Sampling protocols adhered to the Ecological Land Survey Site (Alberta Sustainable Resource Development 2003).

There was a frequent transition from upland to lowland sites resulted in a wide range of site positions, aspects, slope gradients, soil moisture levels, and nutrient regimes. This variation in ecological site conditions was reflected in the diversity of plant community types that were identified. Table 64 provides a summary of the 31 plant communities recorded, including 17 upland and 14 lowland types. Upland plant community types included 11 forest, 3 shrubland, and 3 herbaceous vegetation types. Lowland communities included 6 forest, 4 shrubland, and 4 herbaceous vegetation types. Many of the plant community types identified were also reported to occur in other areas of the boreal forest or parkland. Applying Corns (1983) similarity rating system to correlate plant community types there were a total of 17 previously described or closely related types (i.e. rating 1), and 14 new or poorly correlated types. Communities that are expected to be closely associated with eolian landforms include:

- *Pinus banksiana / Alnus viridis - Vaccinium myrtilloides / Oryzopsis pungens* Forest
- *Pinus banksiana / Arctostaphylos uva-ursi / Apocynum androsaemifolium* Forest
- *Pinus banksiana / Cladina mitis* Forest
- *Populus tremuloides / Vaccinium myrtilloides / Arctostaphylos uva-ursi* Forest
- *Betula papyrifera - Pinus banksiana / Alnus incana* spp. *tenuifolia / Aralia nudicaulis* Forest
- *Amelanchier alnifolia / Arctostaphylos uva-ursi / Oryzopsis pungens* Dwarf-shrubland
- *Arctostaphylos uva-ursi / Calamovilfa longifolia* Dwarf-shrubland
- *Amelanchier alnifolia / Arctostaphylos uva-ursi / Oryzopsis pungens* Dwarf-shrubland
- *Arctostaphylos uva-ursi / Calamovilfa longifolia* Dwarf-shrubland
- *Festuca saximontana - Artemisia campestris* Herbaceous Vegetation
- *Carex siccata - Danthonia spicata* Herbaceous Vegetation
- *Elymus trachycaulus - Carex pensylvanica - Selaginella densa* Herbaceous Vegetation

As indicated by the "Classification Confidence Level" rating and the plant community "Similarity Ratings" many of the communities identified in Table 64 are not well defined and are considered tentative types. Further sampling is recommended to more accurately characterise these and to identify other recurring types associated with eolian landforms. In addition, further literature review may assist in describing these plant community types or identifying other similar types.

Table 64. Summary of plant communities identified in the Holmes Crossing Ecological Reserve and North Buck Lake study area.

Plant community Type	Eolian Affinity	Sample Size	Conf. Level	Site position	Landform	Study Area
Forest/Woodlands						
Pinus banksiana / Alnus viridis - Vaccinium myrtilloides / Oryzopsis pungens Forest	High	2	3	L, gentle slopes	SD, SP	HC
Pinus banksiana / Arctostaphylos uva-ursi / Apocynum androsaemifolium Forest	High	2	3	US, C	SD	HC
Pinus banksiana / Cladina mitis Forest	High	3	1	C, L	SD, SP	NBL, HC
Populus tremuloides / Vaccinium myrtilloides / Arctostaphylos uva-ursi Forest	High	3	2	C to US, L	SD, SP	NBL, HC
Betula papyrifera - Pinus banksiana / Alnus incana spp. *tenuifolia / Aralia nudicaulis* Forest	High	1	3	US to MS	SD	HC
Pinus banksiana / Vaccinium vitis-idaea - Arctostaphylos uva-ursi Forest	Moderate	1	2	L, slight D	SD, SP	NBL
Pinus banksiana / Vaccinium spp. */ Pleurozium schreberi* Forest	Low	3	2	LS to US, TO	SP, SD	HC, NBL
Picea glauca - Picea mariana / Rosa acicularis / Cornus canadensis Forest	Low	1	3	MS to LS	Stream bank	HC
Picea glauca - Picea mariana / Ledum groenlandicum /Equisetum arvense Forest	Low	1	2	L, D	Base of SD	NBL
Picea mariana - Larix laricina / Ledum groenlandicum / Tomentypnum nitens Forest	Low	1	3	L, D	ID	HC
Picea mariana - Larix laricina / Pleurozium schreberi Forest	Low	2	2	L, D	ID	HC, NBL
Picea mariana - Larix laricina Wet Forest	Low	1	3	L, D	ID	NBL
Larix laricina / Betula pumila / Equisetum fluviatile Forest	Low	1	2	L, D	ID	HC
Populus tremuloides / Corylus cornuta / Aralia nudicaulis Forest	Low	1	1	MS	SD, SP	HC, NBL
Populus tremuloides / Rosa acicularis / Aralia nudicaulis Forest	Low	3	2	L, LS	SP, SD	NBL, HC
Populus tremuloides / Alnus viridis / Aralia nudicaulis Forest	Low	5	1	MS TO LS (L)	SP	HC, NBL
Betula papyrifera / Ledum groenlandicum / Equisetum sylvaticum Forest	Low	2	3	D	ID	NBL
Shrubland						
Amelanchier alnifolia / Arctostaphylos uva-ursi / Oryzopsis pungens Dwarf-shrubland	High	6	1	C, US (MS)	SD, SP	HC,NBL
Arctostaphylos uva-ursi / Calamovilfa longifolia Dwarf-shrubland	High	1	3	MS	SD	HC
Betula pumila - (Salix spp.) */ Carex diandra / Aulacomnium palustre* Shrubland	Moderate	1	2	D, L	IW	HC
Salix petiolaris / Carex diandra - Calamagrostis stricta Shrubland	Moderate	3	2	D, L	IW	HC
Alnus viridis spp. *crispa - Prunus pensylvanica / Aralia nudicaulis* Shrubland	Moderate	1	3	US, cool/north	SD, SP	HC, NBL
Salix planifolia / Calamagrostis canadensis Shrubland	Low	1	2	D, L	ID	NBL
Picea mariana / Ledum groenlandicum / Sphagnum fuscum Dwarf-shrubland	Low	1	1	D, L	ID	NBL
Herbaceous Vegetation						
Festuca saximontana - Artemisia campestris Herbaceous Vegetation	High	6	2	C, US	SD	NBL
Carex siccata - Danthonia spicata Herbaceous Vegetation	High	4	2	US to MS	SP, SD	NBL
Elymus trachycaulus - Carex pensylvanica - Selaginella densa Herbaceous Vegetation	High	1	3	MS	SD	HC
Carex diandra Wet Meadow Herbaceous Vegetation	Moderate	1	3	D, L	ID	HC
Calamagrostis canadensis - Potentilla palustris Herbaceous Vegetation	Moderate	3	2	D, L	ID	NBL,HC
Carex utriculata Herbaceous Vegetation	Low	1	3	D	ID	HC
Poa palustris Herbaceous Vegetation	Low	1	2	Beach	Lake Shore	NBL

Study Area: HC = Holmes Crossing Ecological Reserve, NBL = North Buck Lake study area; Landforms: SD = Sand Dunes, ID = Interdune Depression, SP = Sand Plains
Site Position: C = Crest, US = Upper Slope, MS = Mid Slope, LS = Lower Slope, L= Level, D = Depression

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APPENDICES

Appendix I. Plant species list for the Boreal Sand Dunes study.

Codes	*Scientific Name*	Common Name	SRank	GRank	Tracked	Code
ABIEBAL	*Abies balsamea*	balsam fir	S5	G5	N	PGPIN01020
ACHIMIL	*Achillea millefolium*	common yarrow	S5	G5	N	PDAST03030
ACTARUB	*Actaea rubra*	red and white baneberry	S5	G5	N	PDRAN02020
AGROSCA	*Agrostis scabra*	rough hair grass	S5	G5	N	PMPOA04120
ALNUTEN	*Alnus incana ssp tenuifolia*	river alder	S5	G5T5	N	PDBET01022
ALNUVIR	*Alnus viridis*	green alder	S5	G5	N	PDBET01080
ALOPAEQ	*Alopecurus aequalis*	short-awned foxtail	S5	G5	N	PMPOA07010
AMELALN	*Amelanchier alnifolia*	saskatoon	S5	G5	N	PDROS05010
ANDRPOL	*Andromeda polifolia*	bog rosemary	S5	G5	N	PDERI02010
ANDRSEP	*Androsace septentrionalis*	northern fairy candelabra	S5	G5	N	PDPRI02060
ANEMMUL	*Anemone multifida*	cut-leaved anemone	S5	G5	N	PDRAN040E0
ANEMPAR	*Anemone parviflora*	small wood anemone	S5	G5	N	PDRAN040J0
APOCAND	*Apocynum androsaemifolium*	spreading dogbane	S5	G5	N	PDAPO06010
ARABDIV	*Arabis divaricarpa*	purple rock cress	S5	G5	N	PDBRA060G0
ARABHOL	*Arabis holboellii*	reflexed rock cress	S5	G5	N	PDBRA060W0
ARABLYR	*Arabis lyrata*	lyre-leaved rock cress	S4	G5	N	PDBRA06140
ARALNUD	*Aralia nudicaulis*	wild sarsaparilla	S5	G5	N	PDARA02040
ARCTUVA	*Arctostaphylos uva-ursi*	common bearberry	S5	G5	N	PDERI041J0
ARTECAM	*Artemisia campestris*	plains wormwood	S5	G5	N	PDAST0S0D0
ASTECIL	*Aster ciliolatus*	Lindley's aster	S5	G5	N	PDASTE8480
ASTECON	*Aster conspicuus*	showy aster	S5	G5	N	PDASTEB070
ASTELAE	*Aster laevis*	smooth aster	S5	G5	N	PDASTE80Y0
ASTRROB	*Astragalus robbinsii*	Robbins' milk vetch	S3	G5	N	PDFAB0F7P0
ASTRSTR	*Astragalus striatus*	ascending purple milk vetch	S5	G5	N	PDFAB0F061
AULAPAL	*Aulacomnium palustre*	tufted moss				
BETUPAP	*Betula papyrifera*	white birch	S4	G5	N	PDBET020C0
BETUPUM	*Betula pumila*	dwarf birch	S5	G5	N	PDBET020H0
BOTRVIR	*Botrychium virginianum*	Virginia grape fern	S4S5	G5	N	PPOPH010H0
BRACSAL	*Brachythecium salebrosum*					
CALACAN	*Calamagrostis canadensis*	bluejoint	S5	G5	N	PMPOA17050
CALASTR	*Calamagrostis stricta*	narrow reed grass	S4	G5	N	PMPOA17170
CALALON	*Calamovilfa longifolia*	sand grass	S4	G5	N	PMPOA18050
CALTPAL	*Caltha palustris*	marsh-marigold	S5	G5	N	PDRAN06030
CAMPROT	*Campanula rotundifolia*	harebell	S5	G5	N	PDCAM020T0
CAREAQU	*Carex aquatilis*	water sedge	S5	G5	N	PMCYP030V0
CARECUR	*Carex canescens*		S?	G5	N	PMCYP032F0
CARECAN	*Carex canescens ssp canescens*	short sedge	S5	G5T5	N	PMCYP032F4
CARECHO	*Carex chordorrhiza*	prostrate sedge	S5	G5	N	PMCYP032U0
CARECRA	*Carex crawfordii*	Crawford's sedge	S5	G5	N	PMCYP03370
CAREDEW	*Carex deweyana*	Dewey's sedge	S4	G5	N	PMCYP033Q0
CAREDIA	*Carex diandra*	two-stamened sedge	S5	G5	N	PMCYP033R0
CAREDIS	*Carex disperma*	two-seeded sedge	S5	G5	N	PMCYP033U0
CAREINT	*Carex interior*	inland sedge	S3	G5	N	PMCYP036K0
CARELAS	*Carex lasiocarpa*	hairy-fruited sedge	S4	G5	N	PMCYP03720
CARELEP	*Carex leptalea*	bristle-stalked sedge	S5	G5	N	PMCYP037E0
CAREPAP	*Carex paupercula*		S4	G5	N	PMCYP03G30
CAREPEN	*Carex pensylvanica*	sun-loving sedge	S4	G5	N	PMCYP03AC0
CARESIC	*Carex siccata*	hay sedge	S5	G5	N	PMCYP034V2
CAREX$$	*Carex spp.*					
CARETEN	*Carex tenuiflora*	thin-flowered sedge	S3S4	G5	N	PMCYP03DL0
CAREUMB	*Carex umbellata*	umbellate sedge	S1	G5	Y	PMCYP03E60
CAREUTR	*Carex utriculata*	small bottle sedge	S5	G5	N	PMCYP03H90
CAREVAG	*Carex vaginata*	sheathed sedge	S5	G5	N	PMCYP03E90
CLADMIT	*Cladina mitis*	reindeer lichen				
CLADARB	*Cladina arbuscula*	reindeer lichen				
CLADRAN	*Cladina rangiferina*	reindeer lichen				
CLADBEL	*Cladonia bellidiflora*					
CLADCAR	*Cladonia cariosa*					
CLADCOR	*Cladonia cornuta*					
CLADDEF	*Cladonia deformis*					
CLADFUR	*Cladonia furcata*					
CLADGRA	*Cladonia gracilis*					
CLADMUL	*Cladonia multiformis*					
CLADONIA	*Cladonia spp.*					

Appendix I. Plant species list for the Boreal Sand Dunes study.

Codes	Scientific Name	Common Name	SRank	GRank	Tracked	Code
CLADUNC	*Cladonia uncialis*					
CORATRI	*Corallorhiza trifida*	pale coralroot	S5	G5	N	PMORC0M050
CORNCAN	*Cornus canadensis*	bunchberry	S5	G5	N	PDCOR01040
CORNSTOL	*Cornus stolonifera*	red-osier dogwood	S5	G5	N	PDCOR010H0
CORYCOR	*Corylus cornuta*	beaked hazelnut	S5	G5	N	PDBET04030
CREPTEC	*Crepis tectorum*	annual hawk's -beard	SE	G?	N	PDAST2R0M0
DANTSPI	*Danthonia spicata*	poverty oat grass	S1S2	G5	Y	PMPOA200A0
DICRPOL	*Dicranum polysetum*	wavy dicranum				
DISPTRA	*Disporum trachycarpum*	fairybells	S5	G5	N	PMLIL0R060
DICRANU	*Dicranum spp.*					
LYCOCOM	*Diphasiastrum complanatum*	ground-cedar	S5	G5	N	PPLYC01090
DREPADU	*Drepanocladus aduncus*	brown moss				
DRYOCAR	*Dryopteris carthusiana*	narrow spinulose shield fern	S4	G5	N	PPDRY0A040
ELEOPAL	*Eleocharis palustris*	creeping spike-rush	S5	G5	N	PMCYP091E0
ELYMTRA	*Elymus trachycaulus*	slender wheatgrass	S5	G5	N	PMPOA2H0Q0
EPILANG	*Epilobium angustifolium*	common fireweed	S5	G5	N	PDONA06020
EPILPAL	*Epilobium palustre*	marsh willowherb	S3	G5	N	PDONA060R0
EPIPHTES	*Epiphyte spp.*					
EQUIARV	*Equisetum arvense*	common horsetail	S5	G5	N	PPEQU01010
EQUIFLU	*Equisetum fluviatile*	swamp horsetail	S5	G5	N	PPEQU01020
EQUIHYE	*Equisetum hyemale*	common scouring-rush	S5?	G5	N	PPEQU01030
EQUILAE	*Equisetum laevigatum*	smooth scouring-rush	S4	G5	N	PPEQU01040
EQUIPRA	*Equisetum pratense*	meadow horsetail	S5	G5	N	PPEQU01060
EQUISCI	*Equisetum scirpoides*	dwarf scouring-rush	S5	G5	N	PPEQU01080
EQUISYL	*Equisetum sylvaticum*	woodland horsetail	S5	G5	N	PPEQU01090
ERIGGLA	*Erigeron glabellus*	smooth fleabane	S5	G5	N	PDAST3M1P0
ERIOVAG	*Eriophorum vaginatum*	sheathed cotton grass	S5	G5	N	PMCYP0A0C0
EURHPUL	*Eurhynchium pulchellum*					
EVERMES	*Evernia mesomorpha*					
FESTSAX	*Festuca saximontana*	Rocky Mountain fescue	S5	G5	N	PMPOA2V0R0
FRAGVIR	*Fragaria virginiana*	wild strawberry	S5	G5	N	PDROS0R040
GALIBOR	*Galium boreale*	northern bedstraw	S5	G5	N	PDRUB0N0B0
GALILAB	*Galium labradoricum*	Labrador bedstraw	S3	G5	N	PDRUB0N160
GALITRI	*Galium trifidum*	small bedstraw	S5	G5	N	PDRUB0N260
GALITRF	*Galium triflorum*	sweet-scented bedstraw	S5	G5	N	PDRUB0N270
GAULHIS	*Gaultheria hispidula*	creeping snowberry	S3	G5	N	PDERI0F010
GENTAMA	*Gentianella amarella*	felwort	S5	G5	N	PDGEN07010
GEOCLIV	*Geocaulon lividum*	northern bastard toadflax	S5	G5	N	PDSAN04010
GEUMMAC	*Geum macrophyllum*	large-leaved yellow avens	S5	G5	N	PDROS0S080
GEUMTRI	*Geum triflorum*	three-flowered avens	S5	G5	N	PDROS0S0F0
GOODREP	*Goodyera repens*	lesser rattlesnake plantain	S5	G5	N	PMORC17030
GYMNDRY	*Gymnocarpium dryopteris*	oak fern	S5	G5	N	PPDRY0D030
HIERUMB	*Hieracium umbellatum*	narrow-leaved hawkweed	S5	G5?	N	PDAST4W1N0
HIPPVUL	*Hippuris vulgaris*	common mare's-tail	S5	G5	N	PDHPR01030
HORDJUB	*Hordeum jubatum*	foxtail barley	S5	G5	N	PMPOA38070
HUDSTOM	*Hudsonia tomentosa*	sand heather	S3	G5	N	PDCIS03030
HYLOSPL	*Hylocomium splendens*	stair-step moss				
HYPNGYM	*Hypogymnia spp.*					
ICMAERI	*Icmadophila ericetorum*					
IMPANOL	*Impatiens noli-tangere*	western jewelweed	S3	G?	N	PDBAL01070
JUNCBAL	*Juncus balticus*	wire rush	S5	G5	N	PMJUN010A0
JUNCNOD	*Juncus nevadensis*	Nevada rush	S1	G5	Y	PMJUN011Z0
JUNCDUD	*Juncus tenuis*	slender rush	S5	G5	N	PMJUN012S0
KOELMAC	*Koeleria macrantha*	June grass	S5	G5	N	PMPOA3G040
LARILAR	*Larix laricina*	tamarack	S5	G5	N	PGPIN02020
LATHOCH	*Lathyrus ochroleucus*	cream-colored vetchling	S5	G4G5	N	PDFAB250M0
LEDUGRO	*Ledum groenlandicum*	common Labrador tea	S5	G5	N	PDERI0M020
ELYMINN	*Leymus innovatus*	hairy wild rye	S5	G5	N	PMPOA6P090
LILIPHI	*Lilium philadelphicum*	western wood lily	S5	G5	N	PMLIL1A0L0
LINNBOR	*Linnaea borealis*	twinflower	S5	G5	N	PDCPR02010
LONIDIO	*Lonicera dioica*	twining honeysuckle	S5	G5	N	PDCPR03080
LONIINV	*Lonicera involucrata*	bracted honeysuckle	S5	G4G5	N	PDCPR030F0
LYCOANN	*Lycopodium annotinum*	stiff club-moss	S5	G5	N	PPLYC01030
LYCODEN	*Lycopodium dendroideum*	ground-pine	S?	G5	N	PPLYC010B0

Appendix I. Plant species list for the Boreal Sand Dunes study.

Codes	Scientific Name	Common Name	SRank	GRank	Tracked	Code
LYCOANN	*Lycopodium annotinum*	stiff club-moss	S5	G5	N	PPLYC01030
LYCOCLA	*Lycopodium clavatum*	running club-moss	S3	G5	N	PPLYC01080
MAIACAN	*Maianthemum canadense*	wild lily-of-the-valley	S5	G5	N	PMLIL1D010
MELALIN	*Medicago lupulina*	black medick	SE	G?	N	PDFAB2G050
MENYTRI	*Menyanthes trifoliata*	buck-bean	S5	G5	N	PDMNY02010
MERTPAN	*Mertensia paniculata*	tall lungwort	S5	G5	N	PDBOR0N0H0
MITENUD	*Mitella nuda*	bishop's-cap	S5	G5	N	PDSAX0N050
MNIUM$	*Mnium sp.*					
MONEUNI	*Moneses uniflora*	one-flowered wintergreen	S5	G5	N	PDPYR02010
MOSS$$$	*Moss spp.*					
MUHLGLO	*Muhlenbergia glomerata*	bog muhly	S4	G5	N	PMPOA480U0
ORTHSEC	*Orthilia secunda*	one-sided wintergreen	S5	G5	N	PDPYR03010
ORYZPUN	*Oryzopsis pungens*	northern rice grass	S4	G5	N	PMPOA80020
OXYCMIC	*Oxycoccus microcarpus*	small bog cranberry	S5	G5	N	PDERI1V010
PARNPAL	*Parnassia parviflora*	small northern grass-of-parnassus	S2	G4	Y	PDSAX0P0A0
PELTAPH	*Peltigera aphthosa*					
PELTCAN	*Peltigera canina*					
PELTMAL	*Peltigera malacea*					
PELTIGE	*Peltigera spp.*					
PETAPAL	*Petasites frigidus var palmatus*	palmate-leaved coltsfoot	S5	G5T5	N	PDAST71013
PETASAG	*Petasites frigidus var sagittatus*	arrow-leaved coltsfoot	S5	G5	N	PDAST71040
PHALARU	*Phalaris arundinacea*	reed canary grass	S5	G5	N	PMPOA4R030
PICEGLA	*Picea glauca*	white spruce	S5	G5	N	PGPIN03040
PICEMAR	*Picea mariana*	black spruce	S5	G5	N	PGPIN03050
PINUBAN	*Pinus banksiana*	jack pine	S5	G5T5	N	PGPIN040S2
HABEHYP	*Platanthera hyperborea*	northern green bog orchid	S5	G5	N	PMORC1Y0B0
PLEUSCH	*Pleurozium schreberi*	Schreber's moss				
POAINTE	*Poa interior*	inland bluegrass	S5	G5	N	PMPOA4Z170
POAPALU	*Poa palustris*	fowl bluegrass	S5	G5	N	PMPOA4Z1X0
POAPRAT	*Poa pratensis*	Kentucky bluegrass	S5	G5	N	PMPOA4Z210
POHLNUT	*Pohlia nutans*	copper wire moss				
POLYAMP	*Polygonum amphibium*	water smartweed	S5	G5	N	PDPGN0L040
POLYLAP	*Polygonum lapathifolium*	pale persicaria	S5	G5	N	PDPGN0L190
POLYCOM	*Polytrichum commune*	common hair-cap				
POLYPIL	*Polytrichum piliferum*	awned hair-cap				
POLYTRI	*Polytrichum spp.*	hair-cap spp.				
POLYSTR	*Polytrichum strictum*	slender hair-cap				
POPUBAL	*Populus balsamifera*	balsam poplar	S5	G5	N	PDSAL01030
POPUTRE	*Populus tremuloides*	aspen	S5	G5	N	PDSAL010B0
POTENOR	*Potentilla norvegica*	rough cinquefoil	S5	G5	N	PDROS1B160
POTEPAL	*Potentilla palustris*	marsh cinquefoil	S5	G5	N	PDROS24010
PRUNPEN	*Prunus pensylvanica*	pin cherry	S5	G5	N	PDROS1C140
PRUNVIR	*Prunus virginiana*	choke cherry	S5	G5	N	PDROS1C1E0
PTILCRI	*Ptilium crista-castrensis*	knight's plume moss				
PYLAPOL	*Pylaisiella polyantha*					
PYROASA	*Pyrola asarifolia*	common pink wintergreen	S5	G5	N	PDPYR04020
PYROCHL	*Pyrola chlorantha*	greenish-flowered wintergreen	S5	G5	N	PDPYR04030
RANUSCE	*Ranunculus sceleratus*	celery-leaved buttercup	S5	G5	N	PDRAN0L2G0
RIBEGLA	*Ribes glandulosum*	skunk currant	S5	G5	N	PDGRO020J0
RIBEOXY	*Ribes oxyacanthoides*	northern gooseberry	S5	G5	N	PDGRO02180
RIBETRI	*Ribes triste*	wild red currant	S5	G5	N	PDGRO021K0
RORIPAL	*Rorippa palustris*	marsh yellow cress	S5	G5	N	PDBRA270E0
ROSAACI	*Rosa acicularis*	prickly rose	S5	G5	N	PDROS1J010
RUBUACA	*Rubus arcticus*	dwarf raspberry	S5	G5	N	PDROS1K0L0
RUBUIDA	*Rubus idaeus*	wild red raspberry	S5	G5	N	PDROS1K350
RUBUPUB	*Rubus pubescens*	dewberry	S5	G5	N	PDROS1K690
RUMEMAR	*Rumex maritimus*	golden dock	S5	G5	N	PDPGN0P0T0
SALIBEB	*Salix bebbiana*	beaked willow	S5	G5	N	PDSAL020E0
SALICAN	*Salix candida*	hoary willow	S4	G5	N	PDSAL020K0
SALIDIS	*Salix discolor*	pussy willow	S5	G5	N	PDSAL020V0
SALILUT	*Salix lutea*	yellow willow	S5	G4G5	N	PDSAL021S0
SALIMAC	*Salix maccalliana*	velvet-fruited willow	S5	G5?	N	PDSAL021T0
SALIMYR	*Salix myrtillifolia*	myrtle-leaved willow	S5	G5	N	PDSAL021Z0
SALIPED	*Salix pedicellaris*	bog willow	S4	G5	N	PDSAL02240

Appendix I. Plant species list for the Boreal Sand Dunes study.

Codes	*Scientific Name*	Common Name	SRank	GRank	Tracked	Code
SALIPET	*Salix petiolaris*	basket willow	S5	G5	N	PDSAL02280
SALIPLA	*Salix planifolia*	flat-leaved willow	S5	G5	N	PDSAL022B0
SALIPSE	*Salix pseudomonticola*	false mountain willow	S4	G5?	N	PDSAL022E0
SALIPYR	*Salix pyrifolia*	balsam willow	S4	G5	N	PDSAL022G0
SALISCO	*Salix scouleriana*	Scouler's willow	S4	G5	N	PDSAL022M0
SALISER	*Salix serissima*	autumn willow	S4	G4	N	PDSAL022P0
SCHIPUR	*Schizachne purpurascens*	purple oat grass	S5	G5	N	PMPOA5C010
SCIRACU	*Scirpus acutus*	great bulrush	S4	G5	N	PMCYP0Q010
SCUTGAL	*Scutellaria galericulata*	marsh skullcap	S5	G5	N	PDLAM1U0J0
SELADEN	*Selaginella densa*	prairie selaginella	S5	G5	N	PPSEL010C0
SHEPCAN	*Shepherdia canadensis*	Canada buffaloberry	S5	G5	N	PDELG03020
SMILSTE	*Smilacina stellata*	star-flowered Solomon's-seal	S5	G5	N	PMLIL1D040
SMILTRI	*Smilacina trifolia*	three-leaved Solomon's-seal	S5	G5	N	PMLIL1D050
SOLIMIS	*Solidago missouriensis*	low goldenrod	S5	G5	N	PDAST8P100
SOLISPA	*Solidago spathulata*	mountain goldenrod	S5	G5	N	PDAST8P1W0
SONCARV	*Sonchus arvensis*	perennial sow-thistle	SE	G?	N	PDAST8R010
SPHACAP	*Sphagnum capillifolium*	acute-leaved peat moss				
SPHAFUS	*Sphagnum fuscum*	rusty peat moss				
SPHAMAG	*Sphagnum magellanicum*	midway peat moss				
SPHAGNU	*Sphagnum spp.*	peat moss				
SPHEINT	*Sphenopholis intermedia*	slender wedge grass	S3	G5	N	PMPOA5T060
STELCRA	*Stellaria crassifolia*	fleshy stitchwort	S5	G5	N	PDCAR0X090
STELLOF	*Stellaria longifolia*	long-leaved chickweed	S5	G5	N	PDCAR0X0M0
STELLON	*Stellaria longipes*	long-stalked chickweed	S5	G5	N	PDCAR0X0N0
SYMPALB	*Symphoricarpos albus*	snowberry	S5	G5	N	PDCPR05020
SYMPOCC	*Symphoricarpos occidentalis*	buckbrush	S5	G5	N	PDCPR05080
TARAOFF	*Taraxacum officinale*	common dandelion	SE	G5	N	PDAST930Y0
THALVEN	*Thalictrum venulosum*	veiny meadow rue	S5	G5	N	PDRAN0M0Q0
TOFIGLU	*Tofieldia glutinosa*	sticky false asphodel	S5	G5	N	PMLIL1Y030
TOMENIT	*Tomentypnum nitens*	golden moss				
TRIEBOR	*Trientalis borealis*	northern starflower	S4	G5	N	PDPRI0A010
TRIFHYB	*Trifolium hybridum*	alsike clover	SE	G?	N	PDFAB40150
TRIGMAR	*Triglochin maritima*	seaside arrow-grass	S5	G5	N	PMJCG02030
USNELAP	*Usnea lapponica*	old man's beard				
USNEA$$	*Usnea spp.*	old man's beard				
USNESUB	*Usnea substerilis*	old man's beard				
VACCMYR	*Vaccinium myrtilloides*	common blueberry	S5	G5	N	PDERI180M0
VACCVIT	*Vaccinium vitis-idaea*	bog cranberry	S5	G5	N	PDERI18120
VIBUEDU	*Viburnum edule*	low-bush cranberry	S5	G5	N	PDCPR07070
VICIAME	*Vicia americana*	wild vetch	S5	G5	N	PDFAB43020
VIOLADU	*Viola adunca*	early blue violet	S5	G5	N	PDVIO04010
VIOLCAN	*Viola canadensis*	western Canada violet	S5	G5	N	PDVIO040A0
VIOLNEP	*Viola nephrophylla*	bog violet	S4	G5	N	PDVIO04170
VIOLREN	*Viola renifolia*	kidney-leaved violet	S5	G5	N	PDVIO041V0
VULPPIN	*Vulpicida pinastri*					
XANTHAS	*Xanthoria hasseana*					

Appendix II. Results of Detrended Correspondence Analysis of plot data using PC-ORD (Version 4.25).

```
****************** Detrended Correspondence Analysis (DCA) ******************
PC-ORD, Version 4.25
19 Nov 2004,  9:34

DCA 1
Number of non-zero data items:      1458

Downweighting selected.  Weights applied to columns, in sequential order:
 1.000 0.596 1.000 0.431 0.431 0.509 1.000 1.000 1.000 1.000
 1.000 0.431 1.000 0.431 1.000 0.449 1.000 0.783 0.863 1.000
 0.431 0.431 0.431 0.431 1.000 1.000 0.855 0.460 1.000 0.431
 0.924 0.783 1.000 0.821 1.000 0.708 1.000 1.000 0.902 0.460
 1.000 0.684 0.453 0.449 1.000 1.000 1.000 0.749 0.617 0.498
 0.809 0.453 0.431 0.431 0.431 0.863 1.000 0.863 1.000 1.000
 0.659 0.918 1.000 0.615 0.946 0.431 0.431 0.431 0.431 0.597
 0.552 0.776 1.000 1.000 1.000 0.431 0.517 1.000 0.680 1.000
 1.000 1.000 0.431 0.929 0.431 0.431 0.431 0.431 0.431 0.431
 0.431 0.917 0.617 0.796 1.000 1.000 1.000 1.000 1.000 0.863
 1.000 0.609 0.972 0.431 1.000 1.000 0.697 0.487 0.431 0.936
 1.000 1.000 0.431 0.431 0.863 0.894 1.000 0.729 1.000 0.431
 1.000 1.000 1.000 0.519 1.000 1.000 0.431 1.000 0.431 1.000
 0.597 1.000 0.431 0.431 0.431 1.000 0.431 1.000 0.474 0.431
 0.431 1.000 1.000 0.431 0.862 0.431 0.431 0.630 0.863 1.000
 0.431 1.000 0.431 1.000 0.431 0.431 0.431 0.431 0.431 1.000
 0.431 1.000 0.436 0.550 0.924 0.431 0.431 0.431 0.813 1.000
 0.597 1.000 0.431 1.000 0.431 0.597 0.431 1.000 1.000 0.609
 0.638 1.000 0.474 1.000 0.609 1.000 0.431 0.431 0.903 0.431
 0.431 0.577 0.597 0.664 0.522 0.783 1.000 0.734 1.000 1.000
 1.000 1.000 1.000 0.431 0.597 0.431 0.863 0.431 0.813 0.431
 1.000 0.431 1.000 1.000 1.000 0.431 0.863 0.690 1.000 1.000
 1.000 0.433 0.431 1.000 1.000 0.431 1.000 0.531 0.431 0.763
 0.736 1.000 0.519 1.000 0.615 1.000 0.431 1.000 1.000 0.708
 1.000 0.863 1.000 0.431 1.000 1.000 0.431 1.000 1.000 1.000
 1.000 1.000 1.000
Axes are rescaled
Number of segments: 30
Threshold:  0.00

Total variance ("inertia") in the species data:  15.1790

                    ---------- Axis 1 ----------
 0.2629702389 = residual at iteration   0
 0.0968040600 = residual at iteration   1
 0.0244986210 = residual at iteration   2
 0.0079190703 = residual at iteration   3
 0.0068101129 = residual at iteration   4
 0.0030195322 = residual at iteration   5
 0.0025646875 = residual at iteration   6
 0.0011505100 = residual at iteration   7
 0.0009880683 = residual at iteration   8
 0.0004446579 = residual at iteration   9
 0.0003845030 = residual at iteration  10
 0.0001733418 = residual at iteration  11
 0.0001505574 = residual at iteration  12
 0.0000678345 = residual at iteration  13
 0.0000591654 = residual at iteration  14
 0.0000266883 = residual at iteration  15
 0.0000231747 = residual at iteration  16
 0.0000106953 = residual at iteration  17
 0.0000093054 = residual at iteration  18
 0.0000041406 = residual at iteration  19
 0.0000043490 = residual at iteration  20
 0.0000013215 = residual at iteration  21
```

Appendix II. Results of Detrended Correspondence Analysis of plot data using PC-ORD (Version 4.25).

```
0.0000037145 = residual at iteration  22
0.0000004727 = residual at iteration  23
0.1190475598 = residual at iteration  24
0.0063445764 = residual at iteration  25
0.0445261970 = residual at iteration  26
0.0096673742 = residual at iteration  27
0.0056653209 = residual at iteration  28
0.0036140494 = residual at iteration  29
0.0022466285 = residual at iteration  30
0.0014912705 = residual at iteration  31
0.0009280191 = residual at iteration  32
0.0006163297 = residual at iteration  33
0.0003837069 = residual at iteration  34
0.0002549287 = residual at iteration  35
0.0001588938 = residual at iteration  36
0.0001055532 = residual at iteration  37
0.0000657907 = residual at iteration  38
0.0000437332 = residual at iteration  39
0.0000273482 = residual at iteration  40
0.0000181394 = residual at iteration  41
0.0000112172 = residual at iteration  42
0.0000075563 = residual at iteration  43
0.0000046820 = residual at iteration  44
0.0000031206 = residual at iteration  45
0.0000019936 = residual at iteration  46
0.0000016032 = residual at iteration  47
0.0000011653 = residual at iteration  48
0.2303885669 = residual at iteration  49
0.0115810595 = residual at iteration  50
0.0003506005 = residual at iteration  60
0.0000036946 = residual at iteration  70
0.0026632999 = residual at iteration  80
0.0000345992 = residual at iteration  90
0.0000005082 = residual at iteration 100
0.0007267480 = residual at iteration 110
0.0000096942 = residual at iteration 120
0.0032333490 = residual at iteration 130
0.0000472429 = residual at iteration 140
0.0000005483 = residual at iteration 150
0.0022208698 = residual at iteration 160
0.0000228227 = residual at iteration 170
0.0000468319 = residual at iteration 180
0.0000628998 = residual at iteration 190
0.0001568405 = residual at iteration 200
0.0000007513 = residual at iteration 210
0.0049229800 = residual at iteration 220
0.0000653137 = residual at iteration 230
0.0000006551 = residual at iteration 240
0.0005921249 = residual at iteration 250
0.0000077118 = residual at iteration 260
0.0198870935 = residual at iteration 270
0.0012696030 = residual at iteration 280
0.0000082241 = residual at iteration 290
0.0000003215 = residual at iteration 300
0.0006083100 = residual at iteration 310
0.0000054650 = residual at iteration 320
0.0159484260 = residual at iteration 330
0.0001836747 = residual at iteration 340
0.0000018164 = residual at iteration 350
0.0009468747 = residual at iteration 360
0.0000125468 = residual at iteration 370
0.0253839884 = residual at iteration 380
0.0010038624 = residual at iteration 390
```

Appendix II. Results of Detrended Correspondence Analysis of plot data using PC-ORD (Version 4.25).

```
 0.0000147146 = residual at iteration 400
 0.0165320933 = residual at iteration 410
 0.0007467355 = residual at iteration 420
 0.0000054340 = residual at iteration 430
 0.0274292659 = residual at iteration 440
 0.0004935919 = residual at iteration 450
 0.0000065075 = residual at iteration 460
 0.0073069599 = residual at iteration 470
 0.0000988046 = residual at iteration 480
 0.0000022887 = residual at iteration 490
 0.0019169722 = residual at iteration 500
 0.0000288135 = residual at iteration 510
 0.0000101585 = residual at iteration 520
 0.1484064460 = residual at iteration 530
 0.0015916921 = residual at iteration 540
 0.0000116232 = residual at iteration 550
 0.0007812140 = residual at iteration 560
 0.0000117117 = residual at iteration 570
 0.0418574996 = residual at iteration 580
 0.0001863229 = residual at iteration 590
 0.0000028643 = residual at iteration 600
 0.0004720774 = residual at iteration 610
 0.0000073205 = residual at iteration 620
 0.0000662483 = residual at iteration 630
 0.0051104380 = residual at iteration 640
 0.0000780318 = residual at iteration 650
 0.0000013967 = residual at iteration 660
 0.0071194670 = residual at iteration 670
 0.0000881599 = residual at iteration 680
 0.0000009063 = residual at iteration 690
 0.0120708309 = residual at iteration 700
 0.0001696577 = residual at iteration 710
 0.0000024202 = residual at iteration 720
 0.0024696013 = residual at iteration 730
 0.0000343769 = residual at iteration 740
 0.0000002521 = residual at iteration 750
 0.0094927615 = residual at iteration 760
 0.0001403433 = residual at iteration 770
 0.0000022236 = residual at iteration 780
 0.0015595420 = residual at iteration 790
 0.0000162045 = residual at iteration 800
 0.0096977735 = residual at iteration 810
 0.0004224988 = residual at iteration 820
 0.0000047016 = residual at iteration 830
 0.0172148515 = residual at iteration 840
 0.0002469053 = residual at iteration 850
 0.0000027543 = residual at iteration 860
 0.0056762183 = residual at iteration 870
 0.0000650966 = residual at iteration 880
 0.0348629616 = residual at iteration 890
 0.0004047484 = residual at iteration 900
 0.0000047449 = residual at iteration 910
 0.0122945467 = residual at iteration 920
 0.0001578231 = residual at iteration 930
 0.0000020552 = residual at iteration 940
 0.0002424767 = residual at iteration 950
 0.0000037015 = residual at iteration 960
 0.0228236541 = residual at iteration 970
 0.0001794746 = residual at iteration 980
 0.0000008551 = residual at iteration 990
 0.0013641322 = residual at iteration 999
 0.8945347071 = eigenvalue
*** BEWARE *** RESIDUAL BIGGER THAN TOLERANCE, WHICH IS 0.0000001000
```

Appendix II. Results of Detrended Correspondence Analysis of plot data using PC-ORD (Version 4.25).

```
Length of gradient:      7.959
Length of segments:  0.40  0.39  0.38  0.36  0.34  0.31  0.29  0.27  0.24  0.21
Length of segments:  0.18  0.16  0.15  0.14  0.15  0.16  0.18  0.20  0.22  0.20
Length of segments:  0.17  0.15  0.14  0.15  0.16  0.17  0.19  0.20  0.21  0.22
Length of segments:  0.23  0.23  0.21  0.11  0.08  0.08  0.08  0.08  0.08  0.08
Length of gradient:      9.844

Length of gradient:     10.556
Length of segments:  0.26  0.25  0.25  0.24  0.24  0.24  0.25  0.27  0.28  0.27
Length of segments:  0.25  0.23  0.21  0.20  0.21  0.23  0.26  0.27  0.26  0.24
Length of segments:  0.22  0.22  0.22  0.21  0.20  0.20  0.20  0.22  0.26  0.30
Length of segments:  0.31  0.29  0.24  0.19  0.18  0.18  0.20  0.22  0.25  0.27
Length of segments:  0.28  0.26  0.20  0.17  0.16
Length of gradient:     10.490

                 ---------- Axis 2 ----------
 0.2398089916 = residual at iteration   0
 0.0207121540 = residual at iteration   1
 0.0089239823 = residual at iteration   2
 0.0075835153 = residual at iteration   3
 0.0042048716 = residual at iteration   4
 0.0035145332 = residual at iteration   5
 0.0019377953 = residual at iteration   6
 0.0016169508 = residual at iteration   7
 0.0008946412 = residual at iteration   8
 0.0007493552 = residual at iteration   9
 0.0004162877 = residual at iteration  10
 0.0003499313 = residual at iteration  11
 0.0001948600 = residual at iteration  12
 0.0001642199 = residual at iteration  13
 0.0000915615 = residual at iteration  14
 0.0000771620 = residual at iteration  15
 0.0000429797 = residual at iteration  16
 0.0000363351 = residual at iteration  17
 0.0000201823 = residual at iteration  18
 0.0000170653 = residual at iteration  19
 0.0000094463 = residual at iteration  20
 0.0000080322 = residual at iteration  21
 0.0000044156 = residual at iteration  22
 0.0000037889 = residual at iteration  23
 0.0000020658 = residual at iteration  24
 0.0000018036 = residual at iteration  25
 0.0000009059 = residual at iteration  26
 0.0041822996 = residual at iteration  27
 0.0010179664 = residual at iteration  28
 0.0006773428 = residual at iteration  29
 0.0001915030 = residual at iteration  30
 0.0001757940 = residual at iteration  31
 0.0000596469 = residual at iteration  32
 0.0000586263 = residual at iteration  33
 0.0000193281 = residual at iteration  34
 0.0000202655 = residual at iteration  35
 0.0000054017 = residual at iteration  36
 0.0000085276 = residual at iteration  37
 0.0000003473 = residual at iteration  38
 0.0641232654 = residual at iteration  39
 0.0096786162 = residual at iteration  40
 0.0130840838 = residual at iteration  41
 0.0215954762 = residual at iteration  42
 0.0162168294 = residual at iteration  43
 0.0154263927 = residual at iteration  44
 0.0095649473 = residual at iteration  45
```

Appendix II. Results of Detrended Correspondence Analysis of plot data using PC-ORD (Version 4.25).

```
 0.0078220982 = residual at iteration  46
 0.0045784349 = residual at iteration  47
 0.0036116503 = residual at iteration  48
 0.0020866392 = residual at iteration  49
 0.0016327562 = residual at iteration  50
 0.0000299141 = residual at iteration  60
 0.0000005768 = residual at iteration  70
 0.0000283938 = residual at iteration  80
 0.0000006320 = residual at iteration  90
 0.0014781376 = residual at iteration 100
 0.0000308485 = residual at iteration 110
 0.0179619528 = residual at iteration 120
 0.0009588092 = residual at iteration 130
 0.0000186905 = residual at iteration 140
 0.0000126891 = residual at iteration 150
 0.0000000853 = residual at iteration 157
 0.6192286015 = eigenvalue

Length of gradient:     4.082
Length of segments:  0.28  0.28  0.29  0.30  0.30  0.29  0.27  0.25  0.22  0.20
Length of segments:  0.19  0.16  0.15  0.15  0.15  0.14  0.11  0.09  0.09  0.09
Length of segments:  0.09
Length of gradient:     4.944

Length of gradient:     5.095
Length of segments:  0.22  0.20  0.19  0.18  0.18  0.18  0.19  0.19  0.20  0.21
Length of segments:  0.22  0.23  0.23  0.23  0.22  0.22  0.23  0.24  0.25  0.23
Length of segments:  0.17  0.14  0.13  0.13  0.14  0.14
Length of gradient:     5.028

                    ---------- Axis 3 ----------
 0.1126380339 = residual at iteration   0
 0.0644603595 = residual at iteration   1
 0.0043942933 = residual at iteration   2
 0.0019782535 = residual at iteration   3
 0.0004664331 = residual at iteration   4
 0.0002097838 = residual at iteration   5
 0.0000623706 = residual at iteration   6
 0.0000294456 = residual at iteration   7
 0.0000092650 = residual at iteration   8
 0.0000045716 = residual at iteration   9
 0.0000014805 = residual at iteration  10
 0.0000007414 = residual at iteration  11
 0.0000002755 = residual at iteration  12
 0.0907029882 = residual at iteration  13
 0.0113024740 = residual at iteration  14
 0.0301147923 = residual at iteration  15
 0.0021697970 = residual at iteration  16
 0.0012902034 = residual at iteration  17
 0.0002594625 = residual at iteration  18
 0.0001571235 = residual at iteration  19
 0.0000349673 = residual at iteration  20
 0.0000212665 = residual at iteration  21
 0.0000048126 = residual at iteration  22
 0.0000029426 = residual at iteration  23
 0.0000006652 = residual at iteration  24
 0.0000004154 = residual at iteration  25
 0.0000001447 = residual at iteration  26
 0.0001812656 = residual at iteration  27
 0.0000424242 = residual at iteration  28
 0.0000156784 = residual at iteration  29
 0.0000044796 = residual at iteration  30
 0.0000021976 = residual at iteration  31
```

Appendix II. Results of Detrended Correspondence Analysis of plot data using PC-ORD (Version 4.25).

```
 0.0000007014 = residual at iteration  32
 0.0000004137 = residual at iteration  33
 0.0000002385 = residual at iteration  34
 0.1101496369 = residual at iteration  35
 0.0152153959 = residual at iteration  36
 0.0109550394 = residual at iteration  37
 0.0008371857 = residual at iteration  38
 0.0003251712 = residual at iteration  39
 0.0001215950 = residual at iteration  40
 0.0000492965 = residual at iteration  41
 0.0000191847 = residual at iteration  42
 0.0000080499 = residual at iteration  43
 0.0000032080 = residual at iteration  44
 0.0000013583 = residual at iteration  45
 0.0000005617 = residual at iteration  46
 0.0000004457 = residual at iteration  47
 0.0000005199 = residual at iteration  48
 0.0000001071 = residual at iteration  49
 0.1448341608 = residual at iteration  50
 0.0000006754 = residual at iteration  60
 0.0000048462 = residual at iteration  70
 0.0000294132 = residual at iteration  80
 0.0023212289 = residual at iteration  90
 0.0000001148 = residual at iteration 100
 0.0000025999 = residual at iteration 110
 0.0000137237 = residual at iteration 120
 0.0019042946 = residual at iteration 130
 0.0954642594 = residual at iteration 140
 0.0000006332 = residual at iteration 150
 0.0000913391 = residual at iteration 160
 0.0292956177 = residual at iteration 170
 0.0679236948 = residual at iteration 180
 0.0000024715 = residual at iteration 190
 0.0000000744 = residual at iteration 194
 0.4693661332 = eigenvalue

Length of gradient:     4.574
Length of segments:  0.15  0.15  0.15  0.14  0.14  0.15  0.17  0.22  0.27  0.32
Length of segments:  0.36  0.37  0.34  0.29  0.24  0.21  0.18  0.17  0.15  0.11
Length of segments:  0.10  0.10  0.10
Length of gradient:     4.784

Length of gradient:     4.589
Length of segments:  0.19  0.18  0.16  0.16  0.17  0.19  0.20  0.21  0.21  0.22
Length of segments:  0.22  0.23  0.24  0.25  0.24  0.22  0.20  0.18  0.18  0.19
Length of segments:  0.19  0.18  0.17
Length of gradient:     4.442

DCA 1
SPECIES SCORES
    N     NAME      AX1   AX2   AX3        |       RANKED 1          |       RANKED 2
                                           |      EIG=0.895          |      EIG=0.619       |
     1 2BETUPAP     365    73   249        |  134 GCARECRA 1092      |   89 5SALIPSE   546
     2 2PICEGLA     204   333   196        |  151 GELEOPAL 1092      |  200 HEQUISYL   532
     3 2PICEMAR     565    42   321        |  155 GHORDJUB 1092      |    7 1BETUPAP   531
     4 2PINUBAN     343    12   222        |  157 GJUNCDUD 1092      |   75 5BETUPAP   518
     5 2POPUBAL     529    38   228        |  158 GJUNCNOD 1092      |   81 5POPUTRE   514
     6 2POPUTRE     216   144   276        |  161 GPHALARU 1092      |  153 GERIOVAG   512
     7 1BETUPAP     301   531   139        |  166 GSCIRACU 1092      |  109 MSPHAGNU   512
     8 1LARILAR     588   105   251        |  167 GSPHEINT 1092      |   30 3PICEMAR   512
     9 1PICEGLA     453    82   186        |  212 HHIPPVUL 1092      |   28 3OXYCMIC   511
    10 1PICEMAR     419    79   244        |  223 HMENTARV 1092      |  108 MSPHAFUS   510
    11 1PINUBAN     267    22   358        |  226 HPARNPAL 1092      |   61 4PICEMAR   509
```

Appendix II. Results of Detrended Correspondence Analysis of plot data using PC-ORD (Version 4.25).

```
 12 1POPUBAL   212   441    57  |  229 HPOLYLAP 1092 |  217 HLYCOANN   506
 13 1POPUTRE   214   367   104  |  237 HRUMEMAR 1092 |  235 HRUBUACA   503
 14 3ABIEBAL   529    38   228  |  244 HSONCARV 1092 |  102 MPOHLNUT   497
 15 3AMELALN   108   219   412  |  127 GALOPAEQ 1092 |   25 3LEDUGRO   494
 16 3ANDRPOL   623   228   170  |  163 GPOAPALU 1091 |   34 3PRUNPEN   475
 17 3ARCTUVA   118   203   412  |   44 3SALIPSE 1091 |   82 5PRUNPEN   465
 18 3BETUPAP  1063   144   229  |  131 GCAREAQU 1080 |  183 HASTRROB   459
 19 3BETUPUM   840   286   135  |  205 HGALITRI 1080 |  145 GCAREPEN   441
 20 3CORNCAN   247   277   145  |   32 3POPUBAL 1075 |   22 3CORNSTO   441
 21 3CORYCOR   207   339   164  |   18 3BETUPAP 1063 |   91 5VIBUEDU   441
 22 3CORNSTO   213   441    57  |  231 HPOTENOR 1049 |   12 1POPUBAL   441
 23 3GAULHIS   428    67   310  |   66 4SALIPLA 1042 |  206 HGALITRF   441
 24 3LARILAR   621   229   169  |   68 4SALIPED 1042 |   55 4LONIINV   441
 25 3LEDUGRO   480   494   175  |   69 4SALIPET 1042 |   71 4VIBUEDU   440
 26 3LINNBOR   295   241   110  |   87 5SALIPET 1042 |  190 HDISPTRA   440
 27 3LONIINV   224   413    73  |  208 HGEUMMAC 1042 |   52 4CORNSTO   440
 28 3OXYCMIC   470   511   194  |   43 3SALIPLA 1041 |   53 4CORYCOR   440
 29 3PICEGLA   346    52   186  |  189 HCREPTEC 1020 |   56 3LONIDIO   423
 30 3PICEMAR   456   512   195  |  159 GMUHLGLO 1007 |  224 HMERTPAN   418
 31 3PINUBAN   316     4   240  |  187 HCICUMAC 1007 |   48 3VIBUEDU   414
 32 3POPUBAL  1075   172   218  |  130 GCALASTR  984 |   27 3LONIINV   413
 33 3POPUTRE   182   169   128  |  193 HEPILPAL  972 |  171 HANDRSEP   407
 34 3PRUNPEN   103   475   445  |  136 GCAREDIA  933 |  170 HACTARUB   403
 35 3PRUNVIR    85   281   422  |  132 GCARECHO  924 |  156 GJUNCBAL   402
 36 3RIBETRI   409   159   244  |  148 GCAREUTR  912 |  246 HTHALVEN   399
 37 3RUBUIDA   237   336   112  |   42 3SALIPET  894 |  125 GELYMTRA   395
 38 3ROSAACI   204   249   228  |   41 3SALIPED  866 |  248 HTRIEBOR   389
 39 3SALIBEB   836   224   182  |   65 4SALICAN  844 |   49 4AMELALN   384
 40 3SALIMYR   616   350    93  |   19 3BETUPUM  840 |   84 5SALIBEB   381
 41 3SALIPED   866   213   190  |  230 HPOLYAMP  839 |   97 MMOSSES$   379
 42 3SALIPET   894   212   203  |   39 3SALIBEB  836 |   45 3SYMPOCC   375
 43 3SALIPLA  1041   210   218  |  135 GCARECUR  817 |   13 1POPUTRE   367
 44 3SALIPSE  1091   207   217  |  141 GCARELAS  817 |  144 GCAREPAP   365
 45 3SYMPOCC    81   375   355  |   92 MAULAPAL  816 |  147 GCAREVAG   365
 46 3VACCMYR   267   286   138  |   67 4SALIPYR  798 |  198 HEQUIPRA   364
 47 3VACCVIT   332   208   267  |  238 HSCUTGAL  787 |  184 HASTRSTR   363
 48 3VIBUEDU   216   414    68  |   95 MDREPADU  777 |   57 4ROSAACI   362
 49 4AMELALN   150   384    81  |  232 HPOTEPAL  759 |   63 4PRUNPEN   354
 50 4BETUPAP   321   303   105  |   51 4BETUPUM  716 |  142 GCAREUMB   351
 51 4BETUPUM   716   222   183  |  228 HPETASAG  697 |  182 HASTELAE   351
 52 4CORNSTO   214   440    57  |  128 GCALACAN  684 |   40 3SALIMYR   350
 53 4CORYCOR   189   440    76  |  107 MSPHAMAG  672 |  249 HVICIAME   350
 54 4LARILAR   621   229   169  |  185 HCALTPAL  666 |  233 HPYROASA   345
 55 4LONIINV   213   441    57  |   86 4SALIMYR  640 |  239 HSELADEN   344
 56 3LONIDIO   176   423    68  |   88 5SALIPLA  640 |  149 GCAREX$$   343
 57 4ROSAACI   220   362    81  |   90 5SALISER  640 |  242 HSOLIMIS   343
 58 4RUBUIDA   216   323   112  |   77 5LARILAR  632 |  192 HEPILANG   342
 59 4PICEGLA   303   137   178  |  195 HEQUIFLU  628 |  209 HGEOCLIV   342
 60 4POPUTRE   140   246   316  |  110 MTOMENIT  625 |   21 3CORYCOR   339
 61 4PICEMAR   437   509   198  |   16 3ANDRPOL  623 |   76 5BETUOCC   337
 62 4PRUNVIR   167   336   107  |  139 GCAREINT  621 |   37 3RUBUIDA   336
 63 4PRUNPEN   171   354   121  |  168 GTRIGMAR  621 |   78 5PICEGLA   336
 64 4SALIBEB   333   310    85  |  188 HCORATRI  621 |   62 4PRUNVIR   336
 65 4SALICAN   844   219   191  |   24 3LARILAR  621 |  243 HSOLISPA   335
 66 4SALIPLA  1042   218   176  |  204 HGALILAB  621 |    2 2PICEGLA   333
 67 4SALIPYR   798   229   210  |  210 HHABEHYP  621 |  106 MPYLAPOL   333
 68 4SALIPED  1042   210   218  |   54 4LARILAR  621 |  180 HASTECON   332
 69 4SALIPET  1042   218   176  |  222 HMENYTRI  621 |  115 LCLADDEF   331
 70 4SHEPCAN   253   101   365  |  247 HTOFIGLU  621 |  178 HARALNUD   327
 71 4VIBUEDU   192   440    72  |  144 GCAREPAP  619 |   58 4RUBUIDA   323
 72 5ALNUTEN   397   248   126  |  147 GCAREVAG  619 |  203 HGALIBOR   318
 73 5ALNUVIR   202   213   302  |   40 3SALIMYR  616 |  152 GELYMINN   314
 74 5AMELALN   176   239   261  |   79 5PICEMAR  608 |   64 4SALIBEB   310
```

Appendix II. Results of Detrended Correspondence Analysis of plot data using PC-ORD (Version 4.25).

```
  75 5BETUPAP   304   518   134   |   97 MMOSSES$  600 |   202 HFRAGVIR  310
  76 5BETUOCC   372   337    62   |  138 GCAREDIS  596 |   196 HEQUIHYE  309
  77 5LARILAR   632   227   172   |    8 1LARILAR  588 |   216 HLYCODEN  309
  78 5PICEGLA   289   336   110   |  140 GCARELEP  579 |   214 HLATHOCH  306
  79 5PICEMAR   608   269   123   |    3 2PICEMAR  565 |   165 GSCHIPUR  304
  80 5PINUBAN   390    16   242   |  126 GAGROSCA  560 |   104 MPOLYTRI  304
  81 5POPUTRE   245   514   141   |  122 LPELTAPH  537 |    50 4BETUPAP  303
  82 5PRUNPEN   197   465   176   |  240 HSMILTRI  532 |   110 MTOMENIT  292
  83 5PRUNVIR   209    74   399   |    5 2POPUBAL  529 |   169 HACHIMIL  291
  84 5SALIBEB   235   381    96   |  100 MMOSS$$3  529 |   100 MMOSS$$3  289
  85 5SALIMAC   428    67   310   |   14 3ABIEBAL  529 |    19 3BETUPUM  286
  86 4SALIMYR   640   129   419   |  252 EEPIPHYT  519 |    46 3VACCMYR  286
  87 5SALIPET  1042   210   218   |  235 HRUBUACA  491 |   181 HASTECIL  285
  88 5SALIPLA   640   129   419   |  194 HEQUIARV  490 |    35 3PRUNVIR  281
  89 5SALIPSE   293   546   156   |  121 LPELTIGE  488 |    98 MMOSS$$1  279
  90 5SALISER   640   129   419   |   25 3LEDUGRO  480 |    99 MMOSS$$2  279
  91 5VIBUEDU   213   441    57   |  108 MSPHAFUS  471 |    20 3CORNCAN  277
  92 MAULAPAL   816   188   194   |   28 3OXYCMIC  470 |    79 5PICEMAR  269
  93 MBRACSAL   443    86   171   |  220 HMITENUD  466 |   215 HLILIPHI  255
  94 MDICRPOL   337    17   332   |  153 GERIOVAG  456 |   234 HPYROCHL  251
  95 MDREPADU   777   176   261   |  109 MSPHAGNU  456 |    38 3ROSAACI  249
  96 MHYLOSPL   427   131   179   |   30 3PICEMAR  456 |   251 HVIOLADU  249
  97 MMOSSES$   600   379    56   |    9 1PICEGLA  453 |    72 5ALNUTEN  248
  98 MMOSS$$1   381   279   125   |  353 EUSNEA$$  452 |   225 HORTHSEC  246
  99 MMOSS$$2   381   279   125   |   93 MBRACSAL  443 |    60 4POPUTRE  246
 100 MMOSS$$3   529   289   180   |   61 4PICEMAR  437 |    26 3LINNBOR  241
 101 MPLEUSCH   356    28   315   |  133 GCARECAN  428 |   231 HPOTENOR  241
 102 MPOHLNUT   415   497   210   |  146 GCARETEN  428 |   138 GCAREDIS  239
 103 MPOLYPIL    -7   111   -54   |   85 5SALIMAC  428 |    74 5AMELALN  239
 104 MPOLYTRI    70   304   409   |  173 HANEMPAR  428 |   132 GCARECHO  236
 105 MPTILCRI   354    66   262   |   23 3GAULHIS  428 |   230 HPOLYAMP  236
 106 MPYLAPOL   227   333   143   |  120 LICMAERI  428 |   139 GCAREINT  235
 107 MSPHAMAG   672   148   217   |   96 MHYLOSPL  427 |   172 HANEMMUL  232
 108 MSPHAFUS   471   510   196   |   10 1PICEMAR  419 |    67 4SALIPYR  229
 109 MSPHAGNU   456   512   195   |  102 MPOHLNUT  415 |   168 GTRIGMAR  229
 110 MTOMENIT   625   292   124   |   36 3RIBETRI  409 |   188 HCORATRI  229
 111 LCLADONI    17   133   -30   |  225 HORTHSEC  405 |    24 3LARILAR  229
 112 LCLADBEL   161   198    41   |   72 5ALNUTEN  397 |   204 HGALILAB  229
 113 LCLADCAR   182  -124   260   |   80 5PINUBAN  390 |   210 HHABEHYP  229
 114 LCLADCOR   182  -124   260   |   98 MMOSS$$1  381 |    54 4LARILAR  229
 115 LCLADDEF   353   331   266   |   99 MMOSS$$2  381 |   222 HMENYTRI  229
 116 LCLADGRA   104    22   136   |   76 5BETUOCC  372 |   247 HTOFIGLU  229
 117 LCLADMIT   143   -19    88   |  227 HPETAPAL  368 |    16 3ANDRPOL  228
 118 LCLADRAN   110   215   406   |    1 2BETUPAP  365 |    77 5LARILAR  227
 119 LCLADUNC   -18   106    14   |  250 HVIOLREN  362 |   195 HEQUIFLU  227
 120 LICMAERI   428    67   310   |  202 HFRAGVIR  359 |   129 GCALALON  226
 121 LPELTIGE   488   166    49   |  236 HRUBUPUB  357 |   160 GORYZPUN  226
 122 LPELTAPH   537   126   180   |  199 HEQUISCI  356 |    39 3SALIBEB  224
 123 LPELTCAN   151    74   378   |  101 MPLEUSCH  356 |   197 HEQUILAE  224
 124 LPELTMAL    -7   124    83   |  105 MPTILCRI  354 |   236 HRUBUPUB  224
 125 GELYMTRA   -23   395   495   |  217 HLYCOANN  353 |    51 4BETUPUM  222
 126 GAGROSCA   560   138    16   |  115 LCLADDEF  353 |   143 GCARESIC  220
 127 GALOPAEQ  1092   207   217   |  209 HGEOCLIV  346 |    65 4SALICAN  219
 128 GCALACAN   684   215   259   |   29 3PICEGLA  346 |    15 3AMELALN  219
 129 GCALALON    78   226   409   |    4 2PINUBAN  343 |    66 4SALIPLA  218
 130 GCALASTR   984   213   203   |   94 MDICRPOL  337 |    69 4SALIPET  218
 131 GCAREAQU  1080   191   288   |   64 4SALIBEB  333 |   232 HPOTEPAL  217
 132 GCARECHO   924   236   121   |   47 3VACCVIT  332 |   136 GCAREDIA  216
 133 GCARECAN   428    67   310   |  248 HTRIEBOR  327 |   128 GCALACAN  215
 134 GCARECRA  1092   207   217   |  191 HDRYOCAR  321 |   118 LCLADRAN  215
 135 GCARECUR   817   205   212   |   50 4BETUPAP  321 |   159 GMUHLGLO  214
 136 GCAREDIA   933   216   205   |  162 GPOAINTE  317 |   187 HCICUMAC  214
 137 GCAREDEW   209    74   399   |   31 3PINUBAN  316 |   193 HEPILPAL  214
```

Appendix II. Results of Detrended Correspondence Analysis of plot data using PC-ORD (Version 4.25).

```
138 GCAREDIS    596  239  136      |    75 5BETUPAP  304 |  130 GCALASTR  213
139 GCAREINT    621  235  163      |    59 4PICEGLA  303 |   73 5ALNUVIR  213
140 GCARELEP    579   13  366      |     7 1BETUPAP  301 |   41 3SALIPED  213
141 GCARELAS    817  205  212      |    26 3LINNBOR  295 |   42 3SALIPET  212
142 GCAREUMB      2  351  469      |    89 5SALIPSE  293 |  208 HGEUMMAC  210
143 GCARESIC     18  220  268      |    78 5PICEGLA  289 |   68 4SALIPED  210
144 GCAREPAP    619  365   91      |   200 HEQUISYL  285 |   43 3SALIPLA  210
145 GCAREPEN    -25  441  502      |   211 HHIERUMB  285 |   87 5SALIPET  210
146 GCARETEN    428   67  310      |   221 HMELALIN  284 |   47 3VACCVIT  208
147 GCAREVAG    619  365   91      |   180 HASTECON  276 |  134 GCARECRA  207
148 GCAREUTR    912  158  448      |    11 1PINUBAN  267 |  237 HRUMEMAR  207
149 GCAREX$$     47  343  440      |    46 3VACCMYR  267 |  151 GELEOPAL  207
150 GDANTSPI     -7  115   62      |    70 4SHEPCAN  253 |  155 GHORDJUB  207
151 GELEOPAL   1092  207  217      |   152 GELYMINN  253 |  157 GJUNCDUD  207
152 GELYMINN    253  314   94      |   186 HCAMPROT  252 |  158 GJUNCNOD  207
153 GERIOVAG    456  512  195      |   192 HEPILANG  248 |  161 GPHALARU  207
154 GFESTSAX     13  159   35      |   234 HPYROCHL  248 |  163 GPOAPALU  207
155 GHORDJUB   1092  207  217      |   198 HEQUIPRA  247 |  166 GSCIRACU  207
156 GJUNCBAL    163  402   63      |   219 HMAIACAN  247 |  167 GSPHEINT  207
157 GJUNCDUD   1092  207  217      |    20 3CORNCAN  247 |   44 3SALIPSE  207
158 GJUNCNOD   1092  207  217      |    81 5POPUTRE  245 |  212 HHIPPVUL  207
159 GMUHLGLO   1007  214  183      |    37 3RUBUIDA  237 |  226 HPARNPAL  207
160 GORYZPUN    103  226  369      |    84 5SALIBEB  235 |  229 HPOLYLAP  207
161 GPHALARU   1092  207  217      |   106 MPYLAPOL  227 |  244 HSONCARV  207
162 GPOAINTF    317   75   29      |    27 3LONIINV  224 |  223 HMENTARV  207
163 GPOAPALU   1091  207  217      |   249 HVICIAME  223 |  127 GALOPAEQ  207
164 GPOAPRAT     12  186   44      |   224 HMERTPAN  222 |  141 GCARELAS  205
165 GSCHIPUR    174  304   97      |    57 4ROSAACI  220 |  135 GCARECUR  205
166 GSCIRACU   1092  207  217      |   178 HARALNUD  219 |   17 3ARCTUVA  203
167 GSPHEINT   1092  207  217      |    48 3VIBUEDU  216 |  207 HGENTAMA  203
168 GTRIGMAR    621  229  169      |     6 2POPUTRE  216 |  112 LCLADBEL  198
169 HACHIMIL    211  291  179      |    58 4RUBUIDA  216 |  189 HCREPTEC  195
170 HACTARUB    199  403   80      |    13 1POPUTRE  214 |  241 HSMILSTE  194
171 HANDRSEP      6  407  473      |    52 4CORNSTO  214 |  131 GCAREAQU  191
172 HANEMMUL     85  232  483      |    22 3CORNSTO  213 |  205 HGALITRI  191
173 HANEMPAR    428   67  310      |    91 5VIBUEDU  213 |  228 HPETASAG  191
174 HAPOCAND    150  167  438      |   206 HGALITRF  213 |   92 MAULAPAL  188
175 HARABHOL    128  146  322      |    55 4LONIINV  213 |  186 HCAMPROT  188
176 HARABDIV    136  112    3      |    12 1POPUBAL  212 |  164 GPOAPRAT  186
177 HARABLYR    -14  168    3      |   169 HACHIMIL  211 |  201 HERIGGLA  186
178 HARALNUD    219  327  133      |   137 GCAREDEW  209 |  218 HLYCOCOM  180
179 HARTECAM     15  131    8      |    83 5PRUNVIR  209 |   95 MDREPADU  176
180 HASTECON    276  332   80      |    21 3CORYCOR  207 |  185 HCALTPAL  175
181 HASTECIL    171  285  148      |   218 HLYCOCOM  207 |   32 3POPUBAL  172
182 HASTELAE     32  351  467      |    38 3ROSAACI  204 |   33 3POPUTRE  169
183 HASTRROB    -67  459  533      |     2 2PICEGLA  204 |  177 HARABLYR  168
184 HASTRSTR     40  363  426      |    73 5ALNUVIR  202 |  174 HAPOCAND  167
185 HCALTPAL    666  175  289      |   170 HACTARUB  199 |  121 LPELTIGE  166
186 HCAMPROT    252  188  170      |    82 5PRUNPEN  197 |  245 HSTELLON  166
187 HCICUMAC   1007  214  183      |   216 HLYCODEN  193 |   36 3RIBETRI  159
188 HCORATRI    621  229  169      |   233 HPYROASA  193 |  154 GFESTSAX  159
189 HCREPTEC   1020  195  101      |    71 4VIBUEDU  192 |  148 GCAREUTR  158
190 HDISPTRA    190  440   76      |   190 HDISPTRA  190 |  227 HPETAPAL  156
191 HDRYOCAR    321  -28  349      |    53 4CORYCOR  189 |  107 MSPHAMAG  148
192 HEPILANG    248  342   81      |    33 3POPUTRE  182 |  250 HVIOLREN  147
193 HEPILPAL    972  214  187      |   113 LCLADCAR  182 |  175 HARABHOL  146
194 HEQUIARV    490   84  160      |   114 LCLADCOR  182 |   18 3BETUPAP  144
195 HEQUIFLU    628  227  181      |    74 5AMELALN  176 |    6 2POPUTRE  144
196 HEQUIHYE     10  309  510      |    56 3LONIDIO  176 |  219 HMAIACAN  142
197 HEQUILAE     38  224   93      |   241 HSMILSTE  174 |  126 GAGROSCA  138
198 HEQUIPRA    247  364   73      |   165 GSCHIPUR  174 |   59 4PICEGLA  137
199 HEQUISCI    356  134  192      |    63 4PRUNPEN  171 |  238 HSCUTGAL  136
200 HEQUISYL    285  532  136      |   181 HASTECIL  171 |  199 HEQUISCI  134
```

Appendix II. Results of Detrended Correspondence Analysis of plot data using PC-ORD (Version 4.25).

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  201 HERIGGLA    111  186  413      |    62 4PRUNVIR   167 |   111 LCLADONI   133
  202 HFRAGVIR    359  310  322      |   156 GJUNCBAL   163 |   179 HARTECAM   131
  203 HGALIBOR     95  318  463      |   112 LCLADBEL   161 |    96 MHYLOSPL   131
  204 HGALILAB    621  229  169      |   213 HHUDSTOM   157 |    90 5SALISER   129
  205 HGALITRI   1080  191  288      |   123 LPELTCAN   151 |    88 5SALIPLA   129
  206 HGALITRF    213  441   57      |   174 HAPOCAND   150 |    86 4SALIMYR   129
  207 HGENTAMA    145  203  225      |    49 4AMELALN   150 |   122 LPELTAPH   126
  208 HGEUMMAC   1042  210  218      |   214 HLATHOCH   148 |   124 LPELTMAL   124
  209 HGEOCLIV    346  342  105      |   207 HGENTAMA   145 |   150 GDANTSPI   115
  210 HHABEHYP    621  229  169      |   117 LCLADMIT   143 |   176 HARABDIV   112
  211 HHIERUMB    285   34  379      |    60 4POPUTRE   140 |   103 MPOLYPIL   111
  212 HHIPPVUL   1092  207  217      |   246 HTHALVEN   139 |   119 LCLADUNC   106
  213 HHUDSTOM    157 -106   89      |   176 HARABDIV   136 |     8 1LARILAR   105
  214 HLATHOCH    148  306  343      |   215 HLILIPHI   134 |    70 4SHEPCAN   101
  215 HLILIPHI    134  255  418      |   175 HARABHOL   128 |   240 HSMILTRI    97
  216 HLYCODEN    193  309  168      |    17 3ARCTUVA   118 |   220 HMITENUD    92
  217 HLYCOANN    353  506  160      |   251 HVIOLADU   116 |    93 MBRACSAL    86
  218 HLYCOCOM    207  180  236      |   201 HERIGGLA   111 |   194 HEQUIARV    84
  219 HMAIACAN    247  142  280      |   118 LCLADRAN   110 |     9 1PICEGLA    82
  220 HMITENUD    466   92  190      |    15 3AMELALN   108 |   252 EEPIPHYT    81
  221 HMELALIN    284   75  228      |   116 LCLADGRA   104 |    10 1PICEMAR    79
  222 HMENYTRI    621  229  169      |   160 GORYZPUN   103 |   253 EUSNEA$$    78
  223 HMENTARV   1092  207  217      |    34 3PRUNPEN   103 |   221 HMELALIN    75
  224 HMERTPAN    222  418   67      |   203 HGALIBOR    95 |   162 GPOAINTE    75
  225 HORTHSEC    405  246  156      |   172 HANEMMUL    85 |   123 LPELTCAN    74
  226 HPARNPAL   1092  207  217      |    35 3PRUNVIR    85 |    83 5PRUNVIR    74
  227 HPETAPAL    368  156  127      |    45 3SYMPOCC    81 |   137 GCAREDEW    74
  228 HPETASAG    697  191  266      |   129 GCALALON    78 |     1 2BETUPAP    73
  229 HPOLYLAP   1092  207  217      |   104 MPOLYTRI    70 |   120 LICMAERI    67
  230 HPOLYAMP    839  236  153      |   242 HSOLIMIS    48 |    23 3GAULHIS    67
  231 HPOTENOR   1049  241  101      |   149 GCAREX$$    47 |   133 GCARECAN    67
  232 HPOTEPAL    759  217  199      |   184 HASTRSTR    40 |   146 GCARETEN    67
  233 HPYROASA    193  345  157      |   197 HEQUILAE    38 |    85 5SALIMAC    67
  234 HPYROCHL    248  251  173      |   243 HSOLISPA    36 |   173 HANEMPAR    67
  235 HRUBUACA    491  503  192      |   182 HASTELAE    32 |   105 MPTILCRI    66
  236 HRUBUPUB    357  224  110      |   143 GCARESIC    18 |    29 3PICEGLA    52
  237 HRUMEMAR   1092  207  217      |   111 LCLADONI    17 |     3 2PICEMAR    42
  238 HSCUTGAL    787  136  207      |   179 HARTECAM    15 |     5 2POPUBAL    38
  239 HSELADEN    -28  344  488      |   154 GFESTSAX    13 |    14 3ABIEBAL    38
  240 HSMILTRI    532   97  213      |   164 GPOAPRAT    12 |   211 HHIERUMB    34
  241 HSMILSTE    174  194  401      |   196 HEQUIHYE    10 |   101 MPLEUSCH    28
  242 HSOLIMIS     48  343  421      |   171 HANDRSEP     6 |   116 LCLADGRA    22
  243 HSOLISPA     36  335  445      |   142 GCAREUMB     2 |    11 1PINUBAN    22
  244 HSONCARV   1092  207  217      |   245 HSTELLON    -6 |    94 MDICRPOL    17
  245 HSTELLON     -6  166  102      |   150 GDANTSPI    -7 |    80 5PINUBAN    16
  246 HTHALVEN    139  399  161      |   103 MPOLYPIL    -7 |   140 GCARELEP    13
  247 HTOFIGLU    621  229  169      |   124 LPELTMAL    -7 |     4 2PINUBAN    12
  248 HTRIEBOR    327  389   72      |   177 HARABLYR   -14 |    31 3PINUBAN     4
  249 HVICIAME    223  350  104      |   119 LCLADUNC   -18 |   117 LCLADMIT   -19
  250 HVIOLREN    362  147  186      |   125 GELYMTRA   -23 |   191 HDRYOCAR   -28
  251 HVIOLADU    116  249  418      |   145 GCAREPEN   -25 |   213 HHUDSTOM  -106
  252 EEPIPHYT    519   81  380      |   239 HSELADEN   -28 |   113 LCLADCAR  -124
  253 EUSNEA$$    452   78  346      |   183 HASTRROB   -67 |   114 LCLADCOR  -124

DCA 1

SAMPLE SCORES - WHICH ARE WEIGHTED MEAN SPECIES SCORES
    N   NAME        AX1  AX2  AX3      |       RANKED 1         |       RANKED 2
                                       |      EIG=0.895         |      EIG=0.619         |
    1 P01           235  149  294      |    33 P33        1048  |    46 P46          502
    2 P02           123  228  379      |    31 P31         956  |    51 P51          490
    3 P03           233  300  158      |    13 P13         953  |    58 P58          451
    4 P04            87  256  414      |    24 P24         917  |    52 P52          368
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Appendix II. Results of Detrended Correspondence Analysis of plot data using PC-ORD (Version 4.25).

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    5 P05           336  206  237    |    16 P16        913 |     9 P09         353
    6 P06           210   29  185    |    12 P12        893 |    54 P54         352
    7 P07           411   76  276    |    32 P32        835 |    11 P11         349
    8 P08           318  114  284    |    48 P48        728 |    34 P34         331
    9 P09           210  353  115    |    61 P61        704 |    23 P23         326
   10 P10            83  254  380    |    25 P25        685 |    50 P50         319
   11 P11             0  349  444    |    59 P59        637 |    17 P17         315
   12 P12           893  239  160    |    15 P15        605 |     3 P03         300
   13 P13           953  217  192    |    30 P30        604 |    64 P64         288
   14 P14            92  254  382    |    35 P35        560 |    22 P22         284
   15 P15           605  215  206    |    37 P37        494 |    60 P60         266
   16 P16           913  215  201    |    58 P58        449 |    55 P55         265
   17 P17           235  315  156    |    36 P36        422 |    30 P30         262
   18 P18           242  196  263    |    19 P19        418 |     4 P04         256
   19 P19           418  111  205    |     7 P07        411 |    20 P20         256
   20 P20            87  256  387    |    43 P43        349 |    10 P10         254
   21 P21           169  174  325    |    29 P29        338 |    14 P14         254
   22 P22           213  284  211    |     5 P05        336 |    38 P38         247
   23 P23           217  326  147    |    55 P55        329 |    12 P12         239
   24 P24           917  183  342    |     8 P08        318 |     2 P02         228
   25 P25           685  211  258    |    26 P26        306 |    13 P13         217
   26 P26           306  121  367    |    51 P51        301 |    61 P61         217
   27 P27           128  195  396    |    46 P46        300 |    16 P16         215
   28 P28           189  161  385    |    64 P64        270 |    15 P15         215
   29 P29           338   41  323    |    41 P41        270 |    32 P32         213
   30 P30           604  262  148    |    34 P34        252 |    31 P31         213
   31 P31           956  213  208    |    40 P40        245 |    25 P25         211
   32 P32           835  213  198    |    18 P18        242 |    48 P48         207
   33 P33          1048  204  202    |    54 P54        239 |     5 P05         206
   34 P34           252  331  116    |    50 P50        236 |    33 P33         204
   35 P35           560   86  278    |     1 P01        235 |    18 P18         196
   36 P36           422   82  297    |    17 P17        235 |    27 P27         195
   37 P37           494   96  223    |     3 P03        233 |    57 P57         185
   38 P38            66  247  342    |    23 P23        217 |    24 P24         183
   39 P39            41  174  150    |    52 P52        216 |    39 P39         174
   40 P40           245   15  218    |    22 P22        213 |    21 P21         174
   41 P41           270  117  330    |     9 P09        210 |    28 P28         161
   42 P42           195    0  195    |     6 P06        210 |    53 P53         158
   43 P43           349   86  285    |    60 P60        206 |    59 P59         157
   44 P44           119   19   92    |    42 P42        195 |    49 P49         154
   45 P45            45  127   48    |    28 P28        189 |     1 P01         149
   46 P46           300  502  145    |    21 P21        169 |    45 P45         127
   47 P47            96   57  100    |    27 P27        128 |    63 P63         125
   48 P48           728  207  232    |     2 P02        123 |    26 P26         121
   49 P49            43  154  184    |    57 P57        122 |    56 P56         121
   50 P50           236  319  152    |    44 P44        119 |    62 P62         119
   51 P51           301  490  149    |    56 P56        119 |    41 P41         117
   52 P52           216  368  116    |    47 P47         96 |     8 P08         114
   53 P53            37  158   63    |    14 P14         92 |    19 P19         111
   54 P54           239  352  109    |    20 P20         87 |    37 P37          96
   55 P55           329  265  188    |     4 P04         87 |    43 P43          86
   56 P56           119  121   75    |    10 P10         83 |    35 P35          86
   57 P57           122  185  356    |    38 P38         66 |    36 P36          82
   58 P58           449  451  191    |    45 P45         45 |     7 P07          76
   59 P59           637  157  331    |    49 P49         43 |    47 P47          57
   60 P60           206  266  211    |    63 P63         41 |    29 P29          41
   61 P61           704  217  244    |    39 P39         41 |     6 P06          29
   62 P62            23  119    0    |    53 P53         37 |    44 P44          19
   63 P63            41  125  125    |    62 P62         23 |    40 P40          15
   64 P64           270  288  163    |    11 P11          0 |    42 P42           0

**************************** Calculations finished ****************************
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